

Research Quarterly

of the

Association for Health, Physical Education, and Recreation

OCTOBER, 1939

No. 3

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THE ANN ARBOR PRESS

317 Maynard Street

Ann Arbor

Michigan

The Research Quarterly

of the

American Association for Health, Physical Education, and Recreation
ELMER D. MITCHELL, Ph.D., Editor

Vol. X

OCTOBER, 1939

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Published in March, May, October, and December by the American Association for Health, Physical Education and Recreation, 1201 Sixteenth Street, N.W., Washington, D.C. Subscription, \$3.00 per year; single copies, \$1.00.

Send subscriptions to: 1201 Sixteenth Street, N.W., Washington, D.C.

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Respiration in Swimming and Diving

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CORRECT breathing in swimming presents a difficult problem which every instructor and every student has to face. It differs from the breathing on land and is conditioned by psychological, physical, and physiological factors.

Beginners usually experience a certain fear when the face is submerged in water. They are afraid, if not of drowning, at least of inhaling water. This fear usually induces an unnatural respiratory rhythm. They rapidly inhale as much air as they can and then hold it. The familiar choking sensation experienced by beginners is caused by this excessive inhalation.

In the present article, an attempt will be made to analyze only the physical and physiological factors.

PHYSICAL FACTORS

Water Temperature.—The temperature of the water itself has an important influence upon respiration. Since water is a good heat conductor, the loss of heat is greater in water than in air of the same temperature. Thus body metabolism is stimulated, causing in turn greater respiration. Stimulation of the skin by cold water affects also the respiratory center itself. A plunge into cool water usually causes a temporary arrest of respiration on an inspiratory phase. Everyone can easily verify this by stepping under a cold shower. Swimming in cold water will start with a gasping type of respiration which will gradually become slower and more regular. Desirable range: 80° F. for the beginners and 72° F. for competitions.

Water Pressure.—Water exerts .441 lbs. of pressure per square inch for each foot of depth. Therefore, the total water pressure exerted upon the body of a swimmer depends on the depth of the body in the water. In a regular crawl stroke, the median line of the chest and the abdomen are about 5 and 9 inches, respectively, below the water surface, hence the average water pressure exerted upon each square inch of the chest is .182 lbs. and .33 lbs. upon the abdomen. In a fast crawl stroke, when the shoulders and most of the back are exposed above the surface of the water, this pressure is less. In the breast and side strokes these figures will be greater due to the deeper position of the body; in the back stroke water pressure will be somewhat less than in the crawl stroke.

One can ascertain the effect of this pressure by measuring the girth of the chest and the vital capacity of the lungs. The swimmer's chest girth, measured at the nipple level, may be $\frac{3}{4}$ in. smaller, and the vital capacity about 350 cc. less than on the land.

Although the presence of water pressure necessitates a greater respiratory effort, the internal organs are protected by the walls of the body and thus experience only a part of the total pressure.

Schott^{14*} measured the intrathoracic pressure of a man by connecting a manometer with the chest cavity. He found that only 40 per cent of the water pressure was transmitted. In another patient, he found that the transmission of the water pressure to the rectum was also 40 per cent. Bock,³ experimenting with a dead dog, concluded that water pressure was transmitted as much as 70 per cent to the chest organs and about 80 per cent to the abdominal organs. He explained the smaller transmission of the water pressure to the chest organs as the result of the diaphragm moving into the abdominal cavity. Why the diaphragm should move there, against a greater pressure, is not clear. The rigidity of the chest walls seems to be a sufficient reason to explain a lesser transmission of the pressure in the chest than in the abdomen.

Effect of Water Pressure upon the Exhalation.—Since the water pressure causes a certain compression of the chest, it would be logical to conclude that it would favor exhalation. To a certain extent this is true. As a matter of fact, holding the breath under water requires greater effort than on the land. Yet in ordinary swimming, water pressure upon the chest probably does not help one to exhale. Liljestrand and Stenström,¹³ on comparing the records of breathing while lying in water with records obtained on land, found that the time intervals required for exhalation were the same. They concluded that the greater inspiratory effort needed in breathing in water caused a greater tonicity of the inspiratory muscles, and thus necessitated an increase in the subsequent expiratory effort.

Water Pressure against the Nose and the Mouth.—When the nose and the mouth are under water, they are subjected to a pressure depending on the depth of submersion. During exhalation this water pressure has to be overcome, which fact constitutes one of the main obstacles in learning to breathe properly in water. In addition to this, the presence of water around the mouth and nose tends to inhibit respiration. In some animals, such as the muskrat, contact of water with the nostrils will cause them to close. In man, water accidentally drawn into the nose may stop breathing.

Body Buoyancy and Respiration.—With every inhalation body buoyancy increases, and with an exhalation it decreases. Most people

* Refer to numbered Bibliography at end of article.

can float in some position after taking a full breath, but will sink after a full exhalation. Body buoyancy during swimming depends also on another factor. When all parts of the body are in water, buoyancy is the greatest; when some parts, such as the arms in the crawl stroke, are lifted out of the water, buoyancy decreases. To capitalize on these relationships, a general rule may be offered: *Inhale before the body buoyancy is least and exhale when it is greatest.*

PHYSIOLOGICAL FACTORS

Excess Respiratory Work Done in Swimming.—Two methods were offered by Du Bois-Reymond⁶ for determination of the extra work done in breathing in water as compared with breathing on land.

1. He assumed that the surface area of the movable part of the chest is 625 sq. cm., and that the median line of the body lying in water is 12.5 cm. deep. Therefore, he calculated that the water pressure which has to be overcome on inspiration is $625 \times 12.5 = 7812$ gm. (almost 8 kg. or 17.61 lbs.) Inhaling 500 cc. of air will move the chest one centimeter, thus performing $.01 \times 8 = .08$ mkg. of work.

2. The second method suggested by Du Bois-Reymond was as follows: He assumed that in quiet breathing, only 500 cc. of the air will be drawn into the lungs to an average depth of 16 cm. Therefore, an equal amount of water must be displaced from this depth and raised to the surface of water. Work done in lifting this amount of water will be $500 \times .16 = .08$ mkg., exactly the same figure as found by the first method.

Neither Du Bois-Reymond himself nor subsequent investigators were satisfied with the assumption that the movable part of the chest is equal to 625 sq. cm. Undoubtedly its area is greater. But there is another discrepancy in his figures. If the area of 625 sq. cm. moves 1 cm., the amount of air inhaled will be 625 cc. and not 500 cc. Upon inhaling 500 cc. of air, the movement of the chest would be less than 1 cm. There is also no simple and sure way of finding the average depth to which the inhaled air is drawn into the lungs. The fact that the final result of the second method is identical with that calculated by the first method is merely a disturbing coincidence.

Excess Energy Used in Respiration in Swimming.—Liljestrand and Stenström¹³ employed a metabolic method for estimation of excess energy used in respiratory work done in swimming. They tested the oxygen consumption of men lying quietly on the land and then in water of indifferent temperature (34-36° C.). Subtracting the amount of oxygen consumed on land from that consumed in water, it may be found that the amount of oxygen used for extra work in overcoming water pressure ranges from 1.3 to 2.8 cc. for every 1000 cc. of the air, which can also be expressed as equivalent to 0.0065—0.014 calories or 2.77—5.97 mkg. (see also Table I).

Efficiency of the Extra Respiratory Work in Water.—The writer attempted to estimate the efficiency of respiratory work done in water. For this purpose he used the data reported by Liljestrand and Stenström.¹³ In computing the amount of work done, the second method of Du Bois-Reymond was used, and it was assumed that the amount of work done during an exhalation and inhalation were equal. The results are presented in Table I.

It may be seen from Table I that the mechanical efficiency of

TABLE I
RESPIRATION ON LAND AND IN WATER OF INDIFFERENT TEMPERATURE

	Amount of air per min. (cc)	cc of air per inhalation	Oxygen used per min.	Respiratory quotient	Calories per min.	Excess cal. per min.	Excess cal. per inhalation*	Work done per inhalation (mkg.)†	Energy used in one inhalation (mkg.)*	Mechanical efficiency of respiration
Land	8.02	401	258	.78	1.24					
Water	8.46	423	282	.81	1.36	.12	.003	.103	1.2801	8.0
Land	27.0	1.350	269	.79	1.31					
Water	27.4	1.370	323	.79	1.55	.24	.006	.343	2.5602	13.4
Land	42.0	2.100	293	.71	1.37	.29	.0061			
Water	46.1	2.350	352	.73	1.66		.0061	.588	2.6029	22.6

* It was assumed that energy used in inhalation was equal to that of exhalation, thus being equal to one-half of the total energy spent on one respiration.

† The second method of Du Bois-Reymond was used. The amount of water displaced was multiplied by an average depth of 25 cm., which value was given by Liljestrand and Stenström. The respiratory rate was 20 per minute in each test.

extra respiratory work in water is from 8 per cent to 22.6 per cent, becoming more with an increase in depth of respiration.

The Interference of the Arm and Leg Action with Respiration.—For efficient driving with the arms and legs, the chest and the abdomen should be fixed, but proper breathing requires alternating expansion and collapsing of the chest and abdomen. The result is a conflict between the propulsive and respiratory movements. A beginner usually tends to sacrifice breathing for sake of propulsion. Therefore, his respiration becomes irregular and unnatural; he often holds his breath. Incidentally, such respiration causes an increase in blood pressure and beginners may complain of headaches and, in rare cases, even of nose bleeds. An experienced swimmer usually strikes a happy medium. When the distance is short and the speed is essential, he temporarily suspends his breathing, thus gaining in speed. If the distance is considerable, he breathes regularly, trying to avoid fast and shallow respiration.

The Rate and Depth of Respiration.—The respiratory rate in swimming seldom rises above 60 per minute, although Cureton⁶ recorded a rate of 75 per minute in the crawl stroke.

With an increase in rate, the depth usually becomes greater until a certain limit is reached, after which it begins to decrease. Data illustrating this principle are presented in Table II. It may be seen from this table that the figures given by Cureton are the smallest for the corresponding rate. This probably happened because his subjects attempted to inhale air faster than in other experiments. Green⁷ has shown that if the respiratory rate and swimming speed were maintained the same throughout the experiment, the depth would increase due to the cumulative effect of the exercise. In one case the depth increased from 1155 cc. during the first minute to 2851 cc. in the fourth minute. The same was also noted by Schmelkes.¹⁵

Effect of the Length of Inhalation upon Its Depth.—Since inhalation interferes with propelling movements, there is a tendency to take in air as quickly as possible. A shorter inhalation requires greater inspiratory effort if the depth is to remain the same. Suppose a swimmer inhales quietly 500 cc. of air. This usually takes two seconds and requires a negative lung pressure (suction) of about —3 mm. of

TABLE II
RESPIRATORY RATE, LUNG VENTILATION, AND THE DEPTH OF INHALATION
IN SWIMMING

Authors	Respiratory Rate per min.	Lung Ventilation per min. (cc.)	Depth of Inhalation (cc.)	Stroke
Liljestrand and Stenström	30	14000	476	Breast
	50	60000	1200	
Cureton	57	32277	609	Breast
	62	55180	890	
	33	30360	920	Crawl
	35.6	40940	1150	
Schmelkes	54	36828	682	Crawl
	44	49900	1111	
Karpovich	52	71300	1371	Crawl
	20	38740	1937	
Greene	25	25250	1010	Crawl
	34	45560	1340	
	52	62400	1200	
	20	31084	1554	
	20	37802	1890	
	20	57036	2851	
	33	37354	1132	
	33	48856	1480	

mercury. If now he attempts to inhale the same amount of air in .4 seconds, he will need a greater force. $(-3) \times (2:4) = -15$ mm. Since an average swimmer can develop maximum suction of about -70 mm., the greatest volume of air which he can inhale in .4 sec. will be: $500 \times (70:15) = 2334$ cc. If the inhalation time is cut to .2 seconds, this volume will be 1167. Experiments have shown that this maximum of pressure cannot be exerted more than a few times in succession, therefore, the amount of air inhaled will be considerably less (see Table II).

Breathing through the Mouth and the Nose.—Although it is almost universally accepted that a swimmer must inhale through the mouth and exhale through the nose under water, there are circumstances when a different type of breathing should be used. People who have predisposition for sinusitis should avoid exhalation through the nose under water, because this increases the pressure in the nasal cavity and may force undesirable substances into the sinuses. Exhalation through the mouth is safer, especially if performed out of water.

The Voluntary Control of Respiration.—Since very rapid breathing leads to discomfort, decreased efficiency of lung ventilation, and loss of power, swimmers attempt to control the respiratory rate. Coaches seem to agree that an excess number of respirations interferes with the smoothness of motion and slows the speed of the swimmer.

According to Cureton,⁵ complete suspensions of respiration for a distance up to 40 yds. will result in greatest speed. For a 50-yard race he suggests one breath before the turn and one on the way back. For the 100-yard, he recommends that the number of inhalations per lap should correspond to the number of the lap, one during the first lap, two during the second lap, etc. Although this recommendation may be supported by actual tests, nevertheless, some individual modifications may be required. The following case based on Greene's data will illustrate this:

For swimming 100 yards in, say 58 seconds, 15 liters of oxygen may be required. Of this, 13.6 liters may be taken care of by the oxygen debt, which leaves only 1.4 liters of oxygen to be taken in while swimming. Assuming that 5 per cent of atmospheric oxygen may be assimilated, the swimmer will need 28 liters of air. Since 15 breaths are allowed for the 100 yards, it will make the average breath equal to 1867 cc., which lies within the experimentally found range (Table II). Obviously a swimmer with a greater oxygen debt will be able to swim a hundred yards with even fewer breaths. On the other hand, a man whose oxygen debt is less will have a harder time. If the swimmer in the above example had an oxygen debt of 12 liters instead of 13.6, he would have to raise his respiratory depth to over 3700 cc. per breath.

This would be rather difficult to do. Yet one should not be discouraged if with the first trial of Cureton's suggestion no gain in speed is noticed. A change in the manner of breathing may often slow up a swimmer because he is not accustomed to it. Earlier observations made by coaches (Handley⁸) support this view. One should give a fair trial before discarding it.

In distance swimming, respiration is less of a problem, and rhythm in breathing is established more or less automatically.

Respiratory Types.—Aycock and others² have found that under experimental conditions swimmers breathe in a characteristic, individual manner which may be roughly arranged in three groups.

1. An explosion type in which the air is expelled quickly with great force, as if by an explosion.
2. Prolonged type in which the air is expelled gradually.
3. A combination of the prolonged and expulsive types with various degrees of variation.

They also noticed that in all types, with the exception of the back stroke, respiration was synchronized with the stroke, the ratio being one-to-one.*

Expert crawl stroke, while swimming on the back, maintained synchronism. The same investigators noticed that inhalation was usually short and followed immediately by a longer exhalation. The exception was the back stroke, in which inhalation was longer than exhalation and in addition to this the breath was held at the end of an inhalation.†

These investigators do not insist that their findings are final because the number of men tested was small, but even if we assume for a moment that it represents a picture of normal habitual respiration, it is possible to question whether it is the best. It is hard to believe that the one-to-one ratio should be maintained, even though the number of strokes goes to sixty or beyond, and if this ratio is changed, it is quite probable that the breath will be held and even the type of inhalation will be changed. We need more research in this direction.

BREATHING DURING VARIOUS STROKES

Breathing in the Crawl Stroke.—When one arm is raised out of water, its weight lowers body buoyancy, therefore inhalation should precede this, if possible.‡ Since an inhalation causes loss of power, it should not coincide with the maximum arm pull. The best time for

* As many inhalations as strokes by either arm.

† The same was also noticed in two cases of the side stroke. The coincidence of a longer inhalation with holding of the breath seems to be more than casual and needs an explanation, which is impossible at the present for the lack of more data.

‡ The other arm at this moment is extended forward, exerting downward pressure. This also tends to counteract the effect of the lifting of the first arm and facilitates the movement of the head.

inhalation is at the end of the pull of the *top arm* and the beginning of its recovery (Handley⁸). The mouth is brought above the water surface by rotating the head to one side and a slight body roll. The swimmer should avoid excessive raising of his head because it lowers body buoyancy, alters his balance, and increases water resistance (Karpovich¹⁰).

Exhalation should be performed under water because the body equilibrium will be upset the least. Exceptions to this type of exhalation have already been discussed in this paper. Although many swimmers prefer always to breathe on one side, a bi-lateral method may be recommended for better body development, better balance, and for better observation of competitors in a meet. This change may be bothersome at the beginning, but later it should prove advantageous.

Backstroke.—Kohlrausch¹¹ states that experienced backstroke swimmers depend in their breathing mostly on the dorsal expansion of the chest. He points out the advantage of such breathing, because it produces an extra "air-cushion," supporting the body in water. The writer could not observe this peculiarity of breathing among experienced varsity backstrokers. In his opinion the anterior expansion of the chest predominates over the posterior. The sidewise expansion of that side of the chest on which the arm is raised is somewhat greater than on the other side. Since in the backstroke the face is not submerged in water, the whole respiration can be done through the mouth. This type has its advantages over the nasal type because of the larger opening. If an expert crawl stroke swimmer persists in inhaling through the nose while swimming backstroke, it would be better to let him do so rather than cause confusion. According to Aycock et al.,² respiration in this type of swimming may not involve a perfect synchronism with the stroke.

Breast Stroke.—In this stroke, exhalation is made during the glide. The logical moment for an inhalation would be when the arms are brought close to the body because the speed of swimming is the least at that time, and no propulsive movements are made. Yet, at this time, the head of the swimmer goes down so that the mouth may be covered with water, and it would be difficult to inhale without an exaggerated lifting of the head. This necessitates an earlier inhalation. When the arms begin to pull, they move outward and downward, lifting the head out of water. This is an opportune moment for inhalation.

In the butterfly modification of the breast stroke, inhalation is possible only when the arm pull has been almost completed, because the head is then out of the water. Exhalation is performed when the arms strike the water, and continues for some time during the glide.

Overarm Side Stroke.—In this stroke, inhalation starts somewhat before the top arm comes out of water and continues for some time while the arm is being carried above the water. Exhalation is made

simultaneously with the leg kick and continues for some time during the glide.

In the ordinary side stroke, respiration is performed in the same manner as in the overarm type.

In either of these strokes it is possible to breathe in the entirely opposite manner: inhalation during the leg kick and the glide, and exhalation during the recovery; yet swimmers prefer to time the exhalation with the leg kick. This is done, perhaps, because with both the leg kick and the exhalation, the abdominal and thoracic muscles have to contract and, therefore, there is less interference than between the leg kick and inhalation. This consideration suggests another rule for synchronization between the respiratory and propulsive movements: *exhale simultaneously with the leg kick*. Only the crawl and the regular back stroke (inverted crawl) are exempt from this rule; the other strokes, such as breast, inverted breast stroke (double overarm back stroke), butterfly stroke, and side stroke, follow this rule.

Breathing on the Start.—The advantage of good preliminary lung ventilation has long been advocated in athletics. The same principle applies in swimming. A few deep breaths will give sufficient ventilation; too many may cause dizziness. The use of pure oxygen immediately before the start increases the speed of swimming (Karpovich⁹). On the start itself, there is a period of anticipation during which respiration is suspended, otherwise the swimmer may be delayed in starting. Some swimmers succeed in making an exhalation after the starting gun and then inhale while they are in the air. This practice is open to criticism, because it may delay the take-off and it requires extremely vigorous respiration.

Diving.—In fancy diving, breathing does not offer much difficulty. The diver should take a rather moderate breath. A maximum inhalation will result in unnecessary body rigidity and lesser flexibility. To prevent water from getting into the nose while doing stunts under water, the diver should exhale slightly through the nose, especially whenever the head is moving backwards and downwards.

In *distance diving*, one may profit by imitating the professional pearl divers. After a few breaths to ventilate the lungs, they take a final deep, slow breath before diving. If, during the dive, pressure on the chest becomes uncomfortable, relief may be obtained by a partial expiration.

In *depth diving*, breathing is the same as in distance diving, with the exception that no partial exhalation is made if the dive takes a long time. Japanese women pearl divers claim that with the aid of a weight they can go to a depth of about 150 feet. Teruoka¹⁷ tested some of them and found that they actually went to a depth of 98.5 ft. Each dive took about 2.5 minutes, and they usually make about 60 to 90 dives a day, depending on the depth. After each hour of work they

have an intermission of one and one-half hours. Although the water pressure reaches four atmospheres and the time of ascent is only 20 seconds, no ill effect is noticed. It may be of interest to know that some of these divers have small babies whom they suckle during the intermission. Teruoka doubts the possibility of going to a depth of 150 feet, because the time of the descent and ascent will have to be so rapid that one will not be able to adjust to the change of the water pressure.

Lacassagne¹² tested a certain diver who could remain under water 4 min., 14 secs. He noticed that the diver's chest moved rhythmically about 20 times per minute. Although the diver exhaled a certain amount of air, the chest movements did not coincide with this exhalation. Lacassagne came to a conclusion that the diver stored up some air in his stomach, swallowing it before the dive, and then regurgitated it and inhaled during the dive. Lacassagne recommends that every diver develop this regurgitating ability. The present writer has not been able to substantiate this observation; moreover, experiments of Lacassagne are not convincing.

For prolonged staying under water, some means for breathing should be provided. The simplest is to breathe through a tube long enough to reach the water surface. The practicability of such a device is very limited. According to Stigler¹⁶ breathing is ineffective at a depth of three feet and almost impossible at six feet.

The present writer carried out some experiments at Springfield College. Students were asked to breathe through a tube connected with a mercury U tube, and the maximum inspiratory pressure was recorded. It ranged between 80 and 120 mm. of mercury or 42.8 inches and 64.1 inches of water respectively. Then they were submerged in a standing position and had to breathe through a rubber tube connected with a spirometer. The record of the strongest man is as follows:

Depth of water above the head	Vital capacity
0 ft.	3500 cc.
2	2300
3.5	700
4	250
4.25	0

This man had a vital capacity of more than 5000 cc. when on land. His inspiratory force was 120 mm. of mercury, or 64.1 inches of water. It seems that only 64.1 inches or 5.34 feet of water above the mid-level of the chest should neutralize this inspiratory effort. Since the median level of the chest in this case was approximately 18 in. below the top of the head, the actual depth of water which stopped the breathing was 5.75, which is close to 5.34 feet.

Diving just barely under the water surface and breathing through a tube, the end of which projects above the surface, is possible, however, if inhalation is done through the tube and exhalation through the nose. If one attempts to inhale and exhale through the tube, he will be greatly

handicapped. Suppose the tube is two feet long and one inch in diameter, its capacity will be 151 cubic inches or 2474 cc. If we assume the normal capacity of the respiratory dead space as 150 cc., then the total dead space in this case will be 2624 cc. Thus, in each inhalation 2624 cc. of exhaled air will be drawn back into the lungs before fresh air can reach the alveoli.

Helmet Diving.—In recent years helmet diving has become quite popular. It is used for many purposes, including underwater nature study⁴ and even as a help in coaching swimming for observation of action of swimmers under water. Using a rigid helmet into which the air is forced by a good hand pump, it is possible to go to a considerable depth, although it is not very comfortable to go beyond 30 feet.⁴ Since the air pressure in the helmet is slightly above the water pressure around the helmet, the diver exerts no more effort than if he were breathing standing in water up to his shoulders. Helmet diving should not be taken too lightly. Because of the use of compressed air there is a danger of caisson sickness, depending on several factors: the depth of the dive, duration, rapidity of ascent, and individual constitution. Divers should be warned against the practice of "ducking" the helmet and coming to the surface without it. This speeds up the ascent and may result in "diver's bends." Anderson¹ cites a case of a young, healthy diver who remained at a depth of 33 feet for 7 minutes, then ducked the helmet. He developed a serious paralysis of the right arm and leg. Only the energetic treatment in the re-compression chamber saved the man and brought about a complete recovery.

SUMMARY

1. Teaching correct breathing in swimming is an essential part of instruction.
2. Water pressure is transmitted upon the internal organs to the extent of 40 to 70 per cent in the chest and 40 to 80 per cent in the abdomen.
3. Excess energy used in respiration in swimming for each 1000 cc. of air inhaled is 2.77 to 5.97 Kg-m.
4. Mechanical efficiency of the extra respiratory work in water varies from 8 to 22.6 per cent.
5. Headaches and nose bleeds in beginners are due to a disturbance in blood pressure brought about by improper breathing.
6. Respiratory movements interfere with propulsive movements and tend to decrease the speed of swimming.
7. A general rule applied to respiration in swimming: Inhale before the body buoyancy is the least and exhale when it is the greatest.
8. Depth of a breath in swimming varies from 476 to 2851 cc.
9. Very rapid inhaling may become inefficient for a proper lung ventilation.
10. In most of the swimming strokes, exhaling should be done

through the nose and inhaling through the mouth. Back stroke may be an exception.

11. People predisposed or affected by sinusitis should avoid exhaling through the nose under water.

12. Japanese women divers can go to a depth of 98.5 feet without any apparatus except a pair of goggles and a weight.

13. The claim that stunt divers may prolong the duration of submersion by means of inhalation of air regurgitated from the stomach under water seems to be open to doubt.

14. Without the aid of compressed air, submersion to a depth of only 4.25 feet may preclude any possibility of breathing through a tube leading to the surface of water.

15. In helmet diving, "ducking" the helmet should be avoided because it may result in caisson sickness.

Acknowledgment.—I would like to thank Miss Nita Sheffield and Coach Charles Silvia for their help in preparation of this article.

BIBLIOGRAPHY

1. Anderson, W. M., "Caisson Disease during Helmet Diving," *U. S. Naval Med. Bull.*, 25 (July 1927) 628.
2. Aycock, T. M., L. H. Graaff, and W. W. Tuttle, "An Analysis of the Respiratory Habits of Trained Swimmers," *RESEARCH QUARTERLY*, 3:2 (May 1932) 199.
3. Bock, H. E., "Neure Untersuchungen über die mechanisch Wirkung von Bädern," *Zeitschrift f. ges. physic. Therapie* 41 (1931) 42.
4. Conklin, E. G., "The Use of the Diving Helmet in Biological Study," *Sci. Mo.*, 37 (Oct. 1933) 380.
5. Cureton, T. K., "Relation of Respiration to Speed and Efficiency in Swimming," *RESEARCH QUARTERLY*, 1:1 (March 1930) 54.
6. Du Bois-Reymond, R., "Zur Physiologie des Schwimmens," *Arch. f. Anat. und Physiol. (Abt. Physiol.)*, 29 (1905) 252.
7. Greene, M. M., "The Energy Cost of Track Running and Swimming," Master's Thesis, Springfield College, 1930.
8. Handley, L. deB., *Swimming and Watermanship* (New York: the MacMillan Co., 1918).
9. Karpovich, P. V., "The Effect of Oxygen Inhalation on Swimming Performance," *RESEARCH QUARTERLY*, 5:2 (May 1934) 24.
10. Karpovich, P. V., "Water Resistance in Swimming," *RESEARCH QUARTERLY*, 4:3 (Oct. 1933) 21.
11. Kohlrausch, W., "Der Atemtypus bei verschiedenen Sportlichen Übungen," *München med. Wochenschrift*. 68 (1921) 1515.
12. Lacassagne, A., "De la submersion experimental," *Arch. de l'antrop. crim.*, 2 (1887) 226.
13. Liljestrand, G., and N. Stenström, "Studien über die Physiologie de Schwimmens," *Scand. Arch. f. Physiol.*, 39 (1919) 1.
14. Schott, E., "Die Hydrostatische Druckwirkung auf das venöse System als additioneller Factor bei der Virkung von Bädern," *Dtsch. Arch. Klin. Med.*, 140 (1922) 358.
15. Schmelkes, B., "Contribution to Research in Gaseous Exchange in Swimming," *Przegląd Fizjologii Ruchu*, 7 (1935-36) 201; (in Polish).
16. Stigler, "Die Taucherei," *Fortschr. d. naturw. Forsch.*, 9 (1913) 133.
17. Teruoka, G., "Die Ama und ihre Arbeit," *Arbeitsphysiol.*, 5 (1932) 239.

The Development of Public Recreation in Metropolitan Chicago

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FIFTEEN years ago a great research specialist said to the writer that recreation was the most important problem of physical education. This statement was heard with surprise, skepticism, and some degree of condescension. The man was marked as a person who needed "education" in the real significance of physical education. Most physical education specialists would have agreed.

Although we all gave lip service to "education for the wise use of leisure time," we actually did nothing about it except, perhaps, to give more time to archery, tennis, and other sports with a "carry-over" value.

But the problem has been forced upon us. The material framework of our culture has changed at an increasingly rapid rate. It has given the average American longer hours of leisure and more money in his pocket. It has surrounded him with tempting mechanical gadgets for amusement. He has spent more and more freely for pleasure, until our total recreation bill amounted to ten billion dollars in 1930. Less than 3 per cent of this great outlay represented society's effort to provide wholesome recreation. The remaining 97 per cent went into the pockets of amusement vendors, who sold what would sell, good and bad alike.¹

When the depression brought our social problems into sharp focus, we began a tardy effort to catch up with the forces of technology. Our federal government shuffled recreation cards into its new deal. Local governments followed suit. Education looked seriously at recreation. A deluge of writings poured out a rather turbid flood of emotional predictions that the use of leisure would either save or wreck civilization. Only recently have we attempted to clarify our thinking by a rational approach to the question. Needless to say, the painstaking search for factual data, and the objective interpretation of these data, were the first steps in this rational approach.

The study which will be reported very briefly here was an attempt at a small part of such ground work. Chicago presented a fascinating subject to the student of recreation. Its magnificent lake front and its great landscape parks were a striking picture of the beauty a city can gain through recreation development. To one who had been an undergraduate in the dark ages when the cinder-spitting little suburban

¹ J. F. Steiner, *Americans at Play*. (New York: McGraw-Hill Book Co., 1933) 183.

trains of the Illinois Central rattled southsiders past a dreary expanse of railroad lake front, the materialization of the dream city seemed an exciting subject for historical analysis. Moreover, the recreation governments of Chicago have passed through stages of remarkable complexity, as have all phases of its municipal administration. It promised to be a difficult study, therefore an interesting one. Preliminary exploration made it apparent to the investigator that the problem went beyond the city limits into the metropolitan area surrounding them. The automobile extended the Chicagoan's week-end playground to "Chicagoland," as the *Chicago Tribune* calls its map of Illinois, Indiana, and Wisconsin counties within easy touring distance of the city. In return, rapid transportation brought suburbanites to the city's concerts, art galleries, and museums as well as to the bright lights of its commercial amusement centers. This interdependence of interest in recreation was in sharp conflict with the independence of recreation administration, implemented by more than two hundred autonomous governing agencies in the region.

Thus a major problem emerged, and the study was defined. Public recreation was defined as provisions made by tax-supported agencies for leisure-time activities. The investigation included the history, the administration, and the facilities of public recreation in metropolitan Chicago. The procedure followed included the usual techniques of the social sciences. Primary sources of data were secured by:

1. A questionnaire to 244 municipalities, a follow-up questionnaire to 38 cities and follow-up visits to 11, yielding a 59 per cent return, or data on the recreation administration and facilities of 143 of the regional towns and cities.
2. Visits to 33 parks and playgrounds in the city, 18 municipal recreation systems in the region, and 3 county forest preserves.
3. Interviews with 45 persons who had firsthand knowledge of interest to the study.
4. Attendance at official and public meetings regarding recreation.
5. Informal inquiries by correspondence with recreation officials, state planning boards, highway departments, W.P.A. personnel, chambers of commerce, public librarians, railroad passenger agents, and others.
6. Study of administrative reports, official proceedings, special committee reports, tax-rate records, legal codes, maps, plats, real estate records, census reports, newspaper files, city plans, recreation surveys, and the like.
7. A detailed study of Olcott's land value maps of the city of Chicago for 1929 and 1933 in which the mean front foot value of real estate facing each recreation area was computed and compared with the mean value of adjacent property.
8. A study of ten biographical sources for data on 463 Chicago

park commissioners and officials, and an analysis of the material found on 271 of this group who were mentioned in the literature.

9. A detailed study of the files of the *Chicago Tribune* from October, 1872, to October, 1874. All items relating to public recreation, more than three hundred in number, were analyzed.

10. An intensive study of each of the 75 communities of Chicago, involving analysis of census tract data and material in the community studies file of the Social Science Research Committee of the University of Chicago. This material was used in estimating the adequacy of recreation service in the different parts of the city in terms of social need.

To complete the study took the investigator's full time for one year, and almost all of her spare time for three additional years.

The study is reported in three main parts, the city of Chicago, the region, and conclusions. The first two parts are organized alike, discussing the history, the administration, and the facilities of public recreation. The third part includes a statement of emerging regional problems, possible solutions, a summary of important findings, and implications for physical education.

Of course it is impossible to report much of the investigation at this time. Most of the colorful details which make the study of local recreation history a fascinating hobby will, perforce, be omitted. A few of the chief problems and findings will be summarized.

HISTORY

First, what does the history of recreation contribute? When does recreation consciousness develop in a community? This appears to depend on a complex of factors, no one of which was constant for every city studied. Size, local initiative, the example of neighboring cities, the national spread of recreation movements as a part of social reform, the influence of the National Recreation Association—all played varying parts. The example of Chicago was not widely imitated throughout the region.

What is the origin of the assumption that provision for public recreation is a responsibility of government? In almost every community, individuals other than government officials took the initiative. When recreation projects demanded great expenditures, as in the case of the great parks of Chicago, these individuals brought pressure to bear on local public officials. Later, when the general nature of the benefits of public recreation was recognized, governments were willing to assume the responsibility.

How was this responsibility implemented by legislation? Since states control municipalities in the Chicago region, as in most of the nation, the state laws regulate local provisions for recreation. Illinois, Indiana, and Wisconsin not only differ from each other in recreation legisla-

tion, but provide a variety of administrative forms from which cities may choose. City governments, park districts incorporated and independent of city governments, park boards and recreation commissions related to city governments, school boards and independent school districts, townships, counties, states, and the federal government—in all, over one thousand administrative bodies in this region—have been empowered to direct public recreation.² It is estimated that two hundred or more such different governments are administering recreation at the present time.

What were the early purposes of recreation, and how have they changed? The first great landscape parks of Chicago, set up in 1869 during the era of rapid economic and industrial expansion following the Civil War, were pushed by real estate and street railroad interests. They appealed to Chicago's pride in growth, its confidence in its future, and its desire to emulate the elegance of eastern cities. The only large landscape park established early in the suburbs was also a real estate venture. From this beginning, recreation policy continued to expand, in the central city and in regional towns. "Keep off the grass" signs disappeared, tennis courts and ball fields were laid out in the parks. Playgrounds were provided for children of the slums in the summer, then field houses were built so that recreation might continue throughout the year. Activities for youths and adults were introduced, more elaborate play fields provided, and the schools were also used as community centers. Community organization, begun as a war-time measure to unite the nation, has recently been re-emphasized to combat crime and social disorganization, to bring some order out of the tangle of overlapping public and private agencies which are engaged in recreation, and to promote national effectiveness in a period of increasing international tensions. Meanwhile, the program of activities has broadened from sports and physical play to include almost any constructive leisure-time interest; and a definite effort is made to "sell" the program to the public.

The evolution of municipal recreation policy has in part followed public demand, and in part anticipated and created it. Obviously, the share any city has had in recreation pioneering has depended on its recreation executives. Chicago's South Park and consolidated park districts, as well as other recreation governments in the region, have made valuable contributions to establishing municipal recreation policy.

When are the waterfront and waterways recognized as important recreation sources? Perhaps no other phase of recreation history illustrates better the chance operation of local factors than does the use of the lake shore in the Chicago region. Today Chicago's lake front gives it distinctive beauty among the great cities of the world. It is a

² C. E. Merriam, S. D. Parratt, and A. Lepawsky, *The Government of the Metropolitan Region of Chicago*. (Chicago: University of Chicago Press, 1933) 44.

summer playground unequaled in extent and amazing in a city which owes its growth to its strategic position, controlling the central markets and transportation of an industrial continent. How did it happen that the grimy hand of industry fastened only on South Chicago, Hammond, and the southern bend of the lake shore? The answer is found in a fortunate combination of causes: a phrase written on an old map, an abandoned cemetery on the lake shore, the park development of the 70's, the great fair of 1893 which inspired the magnificent Chicago Plan, the civic spirit which fought to carry out the plan, the engineering enterprise which built a park out of the city's waste, and public appreciation of the lake front as a recreation resource.

Perhaps the most dramatic aspect of the story was the struggle against the railroad barrier along the south shore of the lake. It took ten years to solve legal complications, bring the different administrative agencies representing the people into an effective bargaining unit, force the Illinois Central to come to terms, and harmonize the harbor and park plans. It took another ten years to develop the park plans. Through these two decades public interest has grown, the taxpayers have voted enormous sums for the work, although occasionally doubting the efficiency and disinterestedness of the public agents who were carrying it on.

Another dramatic controversy involved the recent attempt to establish a permanent fair on the lake front. Like the Chicago Plan, it evolved from a world's fair, although to most civic organizations this comparison would seem a sacrilege, because the Burnham plan preserved the ideal of civic beauty, while the fair plan, they felt, was a commercial exploitation of the recreational value of the lake front. The city and park administrations, on the other hand, maintain that a permanent fair is the realistic answer to the question, "How can Burnham Park give the greatest recreational value to the people of Chicago?" Political power and strategy gave a legislative victory to the Mayor, but aroused public opinion checked it. It is probable that the citizens will be on guard against similar projects, for the lake front is too large to be forgotten, too close to the emotions of the people to be just another ephemoral issue of politics.

In the region outside the city, the lake front presents a striking pictorial result of the chance operation of local history, private business enterprise, and local political autonomy. Local leaders who promoted the industrial use of the shore line in some cases did, in other cases did not, see the desirability of saving some of it for recreation. Residential suburbs which were started as educational centers dedicated part of the water front to the public in their original plans; residential suburbs which were real estate developments platted all of the valuable lake front property for private sale. Civic pride in some towns took the form of beautifying the shore line through public

ownership, in others it was satisfied by handsome private estates along the lake. Private business enterprise in Chicago was regulated by the Chicago plan, but elsewhere in the region it operated with almost complete laissez-faire in using the water front. Local governments, slow to see the value of recreational use of the lake shore, were handicapped later by rising land values. Additional autonomous governments, such as park districts, established to secure more funds, operated independently and sometimes at cross purposes. With two exceptions, plans made by cities to shape lake front development in relation to the whole growth of the city were not carried out consistently.

The confused unbalance of this picture has been emphasized by the increasing recreational attraction of water and the greater fluidity of the whole population of the region in seeking recreation. A regional problem emerges which goes beyond the power of local governments to solve.

ADMINISTRATION

Second, how is recreation administered? The complexity of administration has been mentioned. In Chicago today, four governments control public recreation: the Chicago Park District, which is a municipal corporation with independent taxing, ordinance-making, policing, and general governing powers, and which controls 5,337 recreation acres; the Cook County Forest Preserve Board of Commissioners, which has 1,578 acres within the city limits; the City Bureau of Parks, Recreation, and Aviation (under the Board of Public Works), which has 390 acres of playgrounds, squares, and beaches; and the Bureau of Recreation under the Board of Education, which has 82 acres of school playgrounds. In addition there is the advisory, non-political Recreation Commission. If this seems complicated, compare it with the picture in 1933, before three large and nineteen small independent park districts were consolidated into the Chicago Park District. Twenty-five governments with one hundred and twenty-nine commissioners went their independent ways in that halcyon day of administrative multiplicity, and the voter's effort to control recreation was completely baffled by the diffusion of responsibility. This complexity of administration within the city is multiplied in the region. In 37 per cent of the regional towns and cities, responsibility for administering recreation is divided between two or more governments. More than two hundred governments conduct recreation in the region as a whole.

How did this complexity develop? First, because city governments, limited in their borrowing powers by constitutional provisions, could not finance the large expenditures necessary for parks. Second, because in the early days City Hall was in disrepute, aldermen could be bought by a supper party, and the schools were not interested in recreation so other agencies were set up to keep the parks out of politics. Third, the principle of autonomous "ad hoc" governments

was well established in American political theory and they seemed a natural implementation for individual pioneering efforts in the new field of public recreation. Only recently has the economic waste and the administrative inefficiency of this maze of duplicating governmental machinery impelled us to consider coordination and consolidation in recreation as in other public functions.

What has been the result of administrative duplication? First, the effort to "keep the parks out of politics" by separating them from City Hall did not work. The commissioners of the West Park and Lincoln Park in Chicago were appointed by the governor, and almost immediately became involved in the game of state politics. South Park commissioners were appointed by the judges of the county circuit court in order to remove them as far as possible from the political arena. For the first few decades of their history this plan did provide an exceptionally able, civic-minded group. But later the booty became so great that the court itself was almost inevitably dragged into politics. The voter has been helpless to prevent poor conduct of recreation because of the lack of a focal point of control, and many examples of waste, inefficiency, even corruption are shown in the study. Recreation expenditures increased rapidly and were not always made wisely. The city of Chicago extends on its tax rolls more than twenty million dollars for the Chicago Park District, although not all of the sum is collected. Twelve cents of the taxpayers' dollar go to the parks, and more than half of this amount is spent in paying up past debts of the twenty-two superseded park districts. Another result of multiplicity of recreation administration has been the lack of unified planning, which, in turn, has meant irregular distribution of recreation areas both within regional cities and throughout the region as a whole.

Although the voter has been unable to exert any consistent control over recreation, on occasions of crisis organized public opinion has brought sufficient pressure to avert what it considered serious misconduct. Moreover, recreation governments have become increasingly sensitive to public opinion. They are eager to promote public participation, and public support as well.

What are the principal forms of administration used? The figures for the region indicate that Park Districts have sole or partial responsibility for administering recreation in 52.5 per cent of the municipalities reporting, school boards in 42 per cent, city governments in 32 per cent, and recreation commissions in 7.35 per cent. This differs from the distribution in the United States, in which the four governments are more equally represented, and probably reflects the influence of Chicago's Park system.

What is the comparative effectiveness of the different types? Eight regional cities, in addition to Chicago, illustrating different forms of administration, were studied in some detail. No one of the four types

appeared to be more effective than the others in all cases. Examples of well conducted recreation systems were found under each type. Moreover, because of the varying forces of local history, it is improbable that if there were one "best" form of government, it could be superimposed on different local backgrounds with equal effectiveness. However, certain factors were common to all the efficient and economical governments. These were: able and relatively permanent executives, freedom from political interference, the utilization of existing facilities, and close coordination between recreation, other branches of local government, and other forms of community organization.

FACILITIES

Third, what facilities for recreation have been provided, and how have they been acquired? Lands and buildings for recreation have been secured by purchase, condemnation, gift, and legalized expansion of the use of existing facilities. Only a few municipalities have followed any consistent plan in developing these facilities, although many have made and abandoned such plans. No comprehensive regional plan has been made. In 1935, Chicago had a little less than 2 recreation acres per 1000 of population, regional municipalities had a median acreage of 5.62, and county and state parks provided 7 acres per 1000 persons in the region. Only 22 per cent of the regional towns and cities provided the 10 recreation acres per 1000 which is often stated as a "standard" by city planning authorities.

Has recreation acreage increased in any constant relation to the population? No, neither in the city nor in the region. While population growth up to 1930 has been steady both in Chicago and in the region, the increase in recreation areas has fluctuated, being affected by the development of recreation consciousness and civic pride, limitations on purchasing power, topography, and city planning.

What types of recreation areas have been provided? The cities have established large and small landscape parks, children's playgrounds, and larger playfields for youths and adults. Chicago has put five-sixths of its recreation acreage into landscape parks, and divides the remaining one-sixth among the other three types. The regional cities, however, have as much acreage in playfield parks as landscape parks; two-fifths of the total in each. The remaining one-fifth is divided between children's playgrounds and small landscape areas. The counties and states have provided large forest preserves.

How are these various facilities distributed? In the city of Chicago, this distribution is very irregular. Two-thirds of the recreation areas have overlapping service zones, while nine of the seventy-five communities have no public play areas. In general, slum areas and the zone of workingmen's homes are under-served, while the better residence districts are over-served. This distribution is in inverse rela-

tion to social need. In slum areas, constructive social forces such as the family, the schools, and the church are handicapped, private welfare work is inadequate, and group mores and traditions break down. On the other hand, destructive social forces such as the gang, commercial recreation, vice, and crime are powerful. While public recreation areas would not solve the problems of social disorganization in the slums, they are potentially useful constructive forces and should be provided. In the zone of workingmen's homes, which is the area of second immigrant settlement, foreign groups need assistance in adjustment, and the social distance between native and foreign groups needs to be bridged. While commercial recreation flourishes, welfare groups and other forms of social organization are lacking, and public recreation is needed. In the zone of better residence, constructive social forces prevail, purchasing power is higher, the need for public recreation less acute.

Some of the cities of the region have well planned, well distributed recreation areas. Kenosha and Gary, for instance, have consistently followed city plans in this respect, and as a result have very few areas of under-service. In other cities, where planning has not functioned, distribution of facilities has been determined by chance operation of local factors, such as gifts of land, pressure from neighborhood improvement clubs and real estate dealers, changes in recreation administration and policy, and the like. Real estate interests have promoted landscape parks in residential districts and opposed playfields and playgrounds in industrial and commercial zones. Their action is based on the fact that recreation areas increase land values in residential zones and decrease them in commercial zones. Landscape parks have more pronounced effects than smaller recreation areas.

Distribution of county and state parks does not meet regional needs. While the Forest Preserves of Cook County provide the city with a belt of parks which may be reached by automobile in an hour or less from the nearest residence district, there is insufficient provision for the day trip to outlying recreation areas which provide water sports. More forest preserves with swimming and boating facilities are needed in the outer zone of the region, where commercial resorts with these facilities can scarcely accommodate at present the week-end and holiday crowds.

REGIONAL PROBLEMS AND POSSIBLE SOLUTIONS

What are the regional problems which emerge from this study? In other words, what are the results of the conflict between functional unity of recreational interests, and structural disunity of recreation governments? Seven important problems have appeared to the investigator.

1. Harmonizing recreation policies. Recreation is the youngest

child of government. Still in the period of rapid growth, its ideology is shifting. Throughout the Chicago region different stages of policy are represented. Conflicts result which must be resolved before any unified attack can be made on other problems. To harmonize recreation policies, however, requires a comprehensive regional point of view.

2. The present irregular and inadequate distribution of recreation facilities throughout the region can be repaired only by long-time regional planning, carried out by continuous coordinated effort.

3. Financial support of recreation varies in amount and source among the different recreation governments. Inequality of recreation opportunity results. Moreover, the fluidity of a pleasure-bent population spreads responsibility for tax-supported recreation beyond the budgets of local governments, and the benefits received are dispersed beyond local boundaries. Regional action is therefore both necessary and equitable.

4. Regulation of the use of recreation facilities is made independently by local governments in the effort to control undesirable conduct of visitors and to maintain social distance between local residents and outsiders. Conflicts and discrimination against various groups result. They cannot be harmonized by local ordinances nor even by state legislation, since there are three states in the region.

5. Transportation provisions affect the accessibility of recreation areas, and must, of course, be planned beyond the limits of any existing government within the region.

6. Conservation of natural resources is recognized as a national problem closely related to recreation. Obviously, it transcends the scope of local or state governments acting independently.

7. Education of the public to appreciate existing recreation facilities and use them wisely is undertaken with varying degrees of effectiveness by different agencies at present. It could be improved if based on regional studies and a unified publicity program.

Can these problems be solved? It may be worth while to examine various possibilities and to attempt a forecast of their results.

1. Maintaining the status quo as the most complete expression of local autonomy will probably result in increase in the number of recreation governments and will provide no remedy for the problems described.

2. Voluntary cooperation between governments through such agencies as the Chicago Regional Planning Association or by some system of voluntary federation might provide at least an approach to general planning and policy making, while leaving local administrative problems to local governments.

3. Consolidation of the governments of Chicago and Cook County would unify the two most powerful recreation governments in the

region. The existing Chicago Park District might be the administrative agency, or a department of recreation under the city-county government might be established. While this would vastly improve conditions in the immediate neighborhood of the city, it would leave untouched problems of the week-end recreation region, and it would fail to provide equality of recreation opportunity for the small towns at the periphery. It would require a constitutional amendment.

4. Interstate compacts have been used to settle general problems and might provide machinery to consider regional recreation. However, this form of cooperation is used and advised for temporary rather than continuing problems.

5. A Metropolitan Park District has been used by some cities to govern regional recreation. Legal complications bar the way to a tri-state district, which would be necessary in the Chicago region. Even if legally possible, such an agency, while consolidating many local governments, would add a specialized administrative unit.

6. The Federal government, through its conservation and relief agencies, might stimulate local governments to cooperative effort. The waste inherent in multiple local administration would continue, however effective the cooperation.

7. Independent statehood for the Chicago area has been proposed to solve other regional problems. It is the most drastic, least possible, but most complete of the various methods suggested to unify recreation administration. Federal action would be necessary to create the new state, and many obstacles are apparent. Nevertheless, the advantages of this solution warrant its serious consideration in any long-time program for recreation in the Chicago region.

IMPLICATIONS FOR PHYSICAL EDUCATION

Finally, what significance does this study have for the student of physical education? How can we use its findings?

To the writer, one important conclusion stands out as we trace the history, study the administration, or analyze the facilities of tax-supported recreation, whether we consider the local or regional recreation picture. Briefly, that conclusion may be stated as follows: public recreation is a social institution which cannot be divorced from its social setting. Treating recreation as an abstract concept is as futile as attempting to teach a child's mind without considering his body. The first step in understanding the recreation problems in our own schools is to orient them in relation to the whole pattern of the environment. To do this we must be informed, not only as to the general social, political, and economic aspects of our culture, but in the fields of local community organization, municipal administration, and economic status of the population in the cities in which we work.

The specific implication is that any person assuming responsibility for the conduct of recreation should have a functional background in the social sciences.

But should the physical education specialist assume this responsibility, either in the school or the community, or both? Because recreation administration cannot be considered apart from its setting, there is no easy answer to this question. The broad nature of the recreation program indicates to the writer that recreation is the concern of the entire school. If responsibility is delegated, it may well be placed in the hands of a recreation coordinator, who should be the best person available for the work. In some schools this will be the physical education instructor, in some it will not.

Should the school administer community recreation? The absurdity of any generalization in the affirmative may be illustrated by saying that since Milwaukee has an exceptionally fine community recreation program under the schools, Chicago should place its public recreation system under the Chicago Board of Education. Throw the sentence into reverse and the absurdity of a flat and final "no" is apparent.

It is obvious that physical education must use much more careful study in defining its function in the recreation field. We have the general obligation of all citizens: to use our own leisure fruitfully and to vote wisely in control and support of public recreation. We share the responsibility of all teachers: to educate others to these two ends and to contribute to the recreational service of the whole school. We have the specialized functions of the teacher who deals in a richly recreational medium, and the still more highly specialized function of the teacher who may be called on to assume responsibility for directing community recreation in a small town in connection with administering physical education. Any searching analysis of professional education in our field will show that we are not training teachers who can do these things. Just as a test of this statement, let me ask how many physical education teachers know enough about the recreation governments of their own communities, their states, or the nation, to use the vote intelligently in support of good recreation programs? How many know what a good modern recreation program is? How many have analyzed closely the recreational possibilities of a good physical education program? Are we not a little hasty in assuming that we should control recreation or that we are ready to set up professional courses to train recreation leaders?

What, then, should we do? In the opinion of the writer the following specific recommendations seem to be indicated at the present time:

1. A closer alliance with social sciences, especially in teacher-training and research programs.
2. Organization, preferably at the high school level, of basic cur-

riculum material designed to teach what the voter needs to know about public recreation.

3. Study of local community recreation history and resources, supplemented by study of student leisure-time activities.

4. Formation of school and community recreation councils which will coordinate curricular and extracurricular experiences, community and school activities.

5. Careful study of the effects of highly organized competition on the recreational values of athletics, music, debate, drama, and arts.

6. Revision of competitive organization on the basis of such study.

7. Adoption of guidance techniques in using recreational activities to aid in personality adjustment and development.

8. Revision of teaching methods, curricular and extracurricular activities in teacher-training institutions, with a view to integrating the experiences of the professional student of physical education into an effective preparation for his functions in the field of recreation.

9. Provision for in-service recreation training of physical education teachers through professional meetings, institutes, conferences, and programs of graduate study.

10. Study of the demand for professionally trained recreation specialists and participation in planning and coordinating such professional curricula as may be necessary.

11. Organization of cooperative research projects in recreation.

12. Cooperation with existing professional organizations in recreation rather than attempts to dominate them or to monopolize the field.

Our profession may choose the easier method of lip service to slogans—"training for the wise use of leisure time"; "teaching sports which have a carry-over value." We may prefer to believe that we have an all-important role in education for recreation, and that we are performing it with credit. But if we are honest in our claims to a scientific pursuit of truth, and if we are mature enough to face reality objectively, we will adopt the more arduous and more humble course of painstaking study and of cooperative experiment.

An Experimental Analysis of Running and of Certain Fundamental Differences Between Trained and Untrained Runners

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INTRODUCTION

PHYSICAL education is concerned primarily with training people to function efficiently. In approaching this problem, the human body must be considered as a complicated machine for producing movements. These movements are changes in the skeletal system of the body. The skeletal system is composed of jointed segments, which are organized, for the most part, about bones. The bones act as levers for the muscles to move and control. The key to human efficiency lies in the nature of the movements produced, the manner in which the movements are produced, and in the coordination of the movements.

The purpose of this study was to determine experimentally the action of certain key muscles of the lower limb in relation to the movements of walking, running, and limb oscillation. Previous studies in the field of human locomotion have either disregarded the intimate relation between the movements and the associated musculature,^{14,15,16,17,18*} or have discussed the relation without making an experimental analysis.^{5,6,12}

The muscles studied were: first, the gluteus maximus, prime extensor of the thigh; second, the rectus femoris, which as a levator of the thigh ranks next to the inaccessible psoas muscle and can also extend the knee; third, the vastus medialis which helps to extend the knee; and last, the gastrocnemius, the foot extensor (see Figure I).

APPARATUS

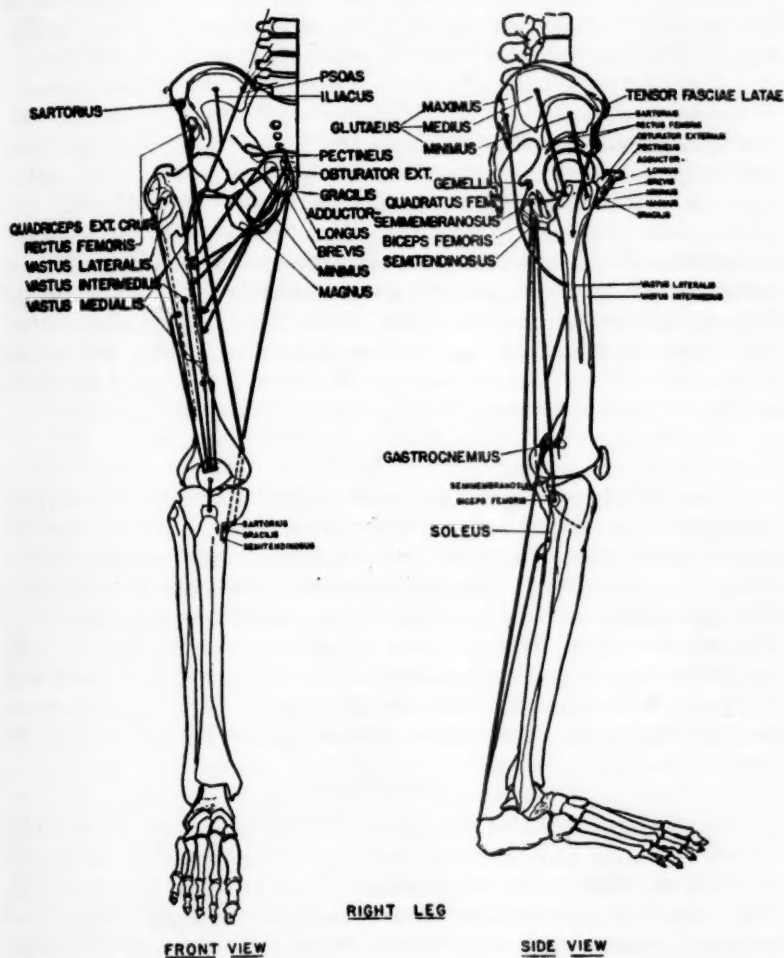
In order to keep the subjects in range of the recording apparatus, they walked and ran on a treadmill which was originally built by Lumley (1931)¹⁹ for a study of running and breathing movements. Every effort was made to attain normal running conditions. The attach-

The problem of this study was formulated and the experimental work was done in the Psychological Laboratory at Oberlin College. Dr. R. H. Stetson, Dr. C. V. Hudgins, and Mr. J. M. Snodgrass rendered much valuable assistance.

* Indices refer to Bibliography at end of article.

ments of the recording apparatus were so light and flexible that the runners were not aware of them while they were running.

The recording apparatus was designed to show the nature of the movements and the action of the muscles in producing the movements. The movements were recorded directly with a delicate thread-and-



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FIGURE I. The bones and muscles of the lower limb.

rubber-band system which has been described by Stetson (1905),²³ by Bingham (1910),² and by Stetson and Bouman (1935).²⁴ At the same time the action of the muscle, as it bulged in applying tension to the limb, was recorded by means of a pneumatic system. Some features

of pneumatic recording have been described by Stetson and Hudgins (1930).²⁵ The pneumodeik has been described by Hudgins and Stetson (1932).¹³ These two aspects of muscular action were recorded simultaneously on the kymograph. The apparatus was carefully built, checked, and calibrated to insure accuracy and to eliminate artifacts.

In order to confirm the kymographic material, action currents from the muscles studied were also recorded simultaneously in an oscillograph. The joint records showed conclusively that the muscle bulges, as recorded kymographically, were accompanied by action currents. However, it was difficult to correlate the oscillographic material with the kymographic material. To avoid this, a direct tracing of the limb oscillation movement and the accompanying muscle bulges and action currents was recorded in the oscillograph (see Figure II, part C). This proved conclusively that the muscle bulges were accompanied by action currents and that the pneumatic system was recording the active tension in the muscle. Since the beginning of the muscle bulge followed the beginning of the action current by a fairly constant interval, it was evident that there was no danger of placing the muscle action too early in the course of the movement if the beginning of the bulge were used to indicate the beginning of the muscle action.

PROCEDURE

Ten subjects were used; five were trained runners and five were untrained. The trained runners were not in training at the time the records were taken. Three or four records of each movement were taken from each subject. The recordings were in the nature of samples. The kymograph was started when the movement was going smoothly. The subjects chose their own rate in walking and running. In limb oscillation the subject was instructed to swing the limb back and forth at a brisk rate. Sometimes the subject was instructed to increase the rate during the recording in order to get a "breakdown" of the movement.

RESULTS

Two general types of movement can be produced by muscular action. When the agonist moves the limb by outpulling the antagonist, we have so-called "tense movements." These are slow and inefficient. The continued use of these tense movements leads to occupational neuroses: such as, piano arm, writer's cramp, glass arm, etc. The second type of movement is efficient. In these, the agonist contracts suddenly during relaxation of its antagonist. This sudden impulse develops momentum in the limb and the limb continues through its course even though the muscle relaxes after the impulse. Since these movements have a phase during which the limb moves by momentum we call them "ballistic," or thrown, movements. These two types of movement, tense and ballistic, were first recognized by Beaunis (1885,

1889)¹ and Richer (1901).²⁰ They have also been discussed by Stetson (1903, 1905),^{22, 23} by Rieger (1903),²¹ by Wachholder (1928),²⁸ by Stetson and Bouman (1935),²⁴ and by Hartson (1932).⁹

The efficiency of a muscle in developing tension, or contracting, depends on the conditions under which tension is developed.^{4,7,8,10,11,27} Those muscular contractions are most efficient in which the muscle does not shorten as it develops tension. These non-shortening contractions are called "isometric." If the muscle is allowed to shorten freely, it soon uses up so much tension for shortening that none is available for the work of moving the limb. Our most efficient movement, then, is the ballistic movement driven by an isometric contraction, a thrown movement in which the driving muscle wastes no tension in shortening.

When the limb moves to-and-fro, as in limb oscillation (Figure II), a maximum driving contraction will produce a stroke of maximum velocity. With maximum velocity the limb attains maximum momentum. This momentum must be degenerated at the end of each stroke and the movement reversed. This takes a definite length of time, so that when both strokes of a to-and-fro, reciprocal movement reach maximum velocity, the rate of movement can only be increased by decreasing the amplitude of each ballistic stroke. If the rate is pushed farther, it eventually reaches a point at which the contractions of the antagonistic muscles overlap and the movement cycle breaks down. This "breakdown" is a momentary fixation, a form of tense movement. When kept below this breakdown rate, these reciprocal movements are highly efficient, since the strokes are ballistic and the movements are driven by essentially isometric contractions.

The striking thing about these swift and highly efficient, reciprocal movements is that the contractions of the driving muscles occur before the end of the preceding stroke. In this way a single, brief contraction stops one stroke and drives the next in the opposite direction. This sudden, driving contraction develops while the muscle is first lengthening and then stationary. It is not shortening during the period of tension development, as can be seen from the records of the action current (Figure II). This makes the contraction essentially isometric and highly efficient.

So far we have talked only of distal movements. Stetson and Throner (1936)²⁸ have pointed out that posture is a shifting series of movements to retain balance and to meet the repercussion of external movements with the mass and momentum of bodily segments. Posture should always be loose and ballistic, for in this way the muscles, rather than opposing each other, oppose forces which by movement across the joints would lengthen them. This makes their contractions essentially isometric. By keeping postural movements loose and ballistic, the tiresome, tense movements which lead to occupational neuroses are avoided, and the reaction of the external movements is met with

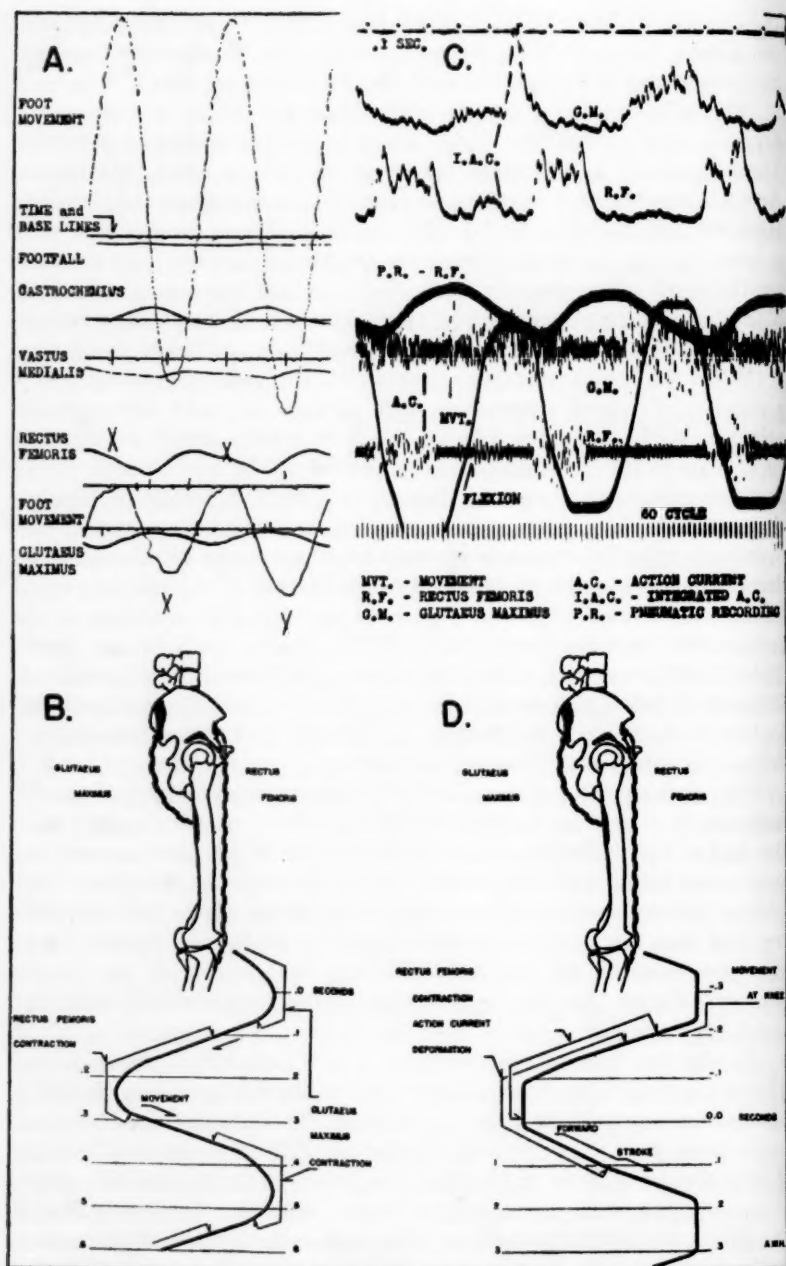


FIGURE II. The driving contractions in limb oscillation: (A) excerpt from kymograph record of limb oscillation; (B) drawing based on averages of read-

the mass and momentum of bodily segments. Often, as in putting the shot and boxing, the repercussion of the arm movement is balanced by the momentum of the trunk. In the javelin throw the body is actually stopped by the recoil of the throwing motion.

In walking and running (Figure III) these highly efficient, reciprocal ballistic movements are used for the purpose of locomotion.* A muscle stops one stroke and produces the next with a single contraction in which the driving force is developed as the muscle is being lengthened. No tension is wasted in shortening the driving muscles. These contractions precede the strokes that they produce and disappear as the strokes enter the ballistic phases. The thigh muscles alternate in throwing the limb to and fro. This gives them ample time for relaxation and recovery, and no muscular tension is wasted by the opposition of antagonistic muscles.

The difference between walking and running is not merely a difference in rate of movement. The rectus femoris, gluteus maximus, and gastrocnemius muscles function in much the same way in both cycles. However, the velocity and length of the strokes is greater in running, so that the forces to be generated and degenerated are greater and the contractions of the gluteus maximus and rectus femoris enter earlier in the preceding stroke. The vastus medialis changes its function entirely. In walking it contracts during much of the backward stroke and preserves the extension of the knee as the body passes over the foot. In running it begins to contract after the foot has left the tread (X, Figure III) and serves to keep the foot from flying up too high behind and then to throw the foot forward with greater velocity about halfway through the forward stroke.

We mentioned above that these reciprocal ballistic movements lose amplitude and break down at a certain rate. This effect was noticed in one of the runners (see Figure IV). As his rate increased from about 3 steps a second to $4\frac{1}{2}$ steps a second, his strokes lost amplitude. A further increase would have caused the runner to "break." This effect is noticed in track athletics where a runner in trying to run faster actually slows down before his coordination goes to pieces and he "breaks."

It is rather evident that improvement in running is not a matter of learning to take more steps a second, but of lengthening each stride.

* Kreezer and Glanville (1937)¹⁸ in a study of walking, have also shown the presence of ballistic movements without recognizing them to be ballistic.

ings from kymograph record above; (C) oscillograph record of limb oscillation; (D) drawing based on averages of readings from oscillograph record.

Friction in the recording system caused the truncated tracing of the knee movement in C and D. Note that each stroke is driven by a muscle (representative of a muscle group) which is lengthened as it develops tension and which decelerates the limb, reverses the direction of its movement, and accelerates it with a single contraction.

A comparison of trained and untrained runners shows this clearly, for both groups took practically the same number of steps a second, but the trained runners' ballistic strokes were longer and of greater velocity. The length of the foot strokes of the trained runners exceeded those of the untrained runners by an average of 18.5 cm., or about 16 per cent. The velocity of the forward stroke of the foot by the trained runners averaged 29 per cent faster before the acceleration of the foot by the vastus medialis and 20 per cent faster after the acceleration.

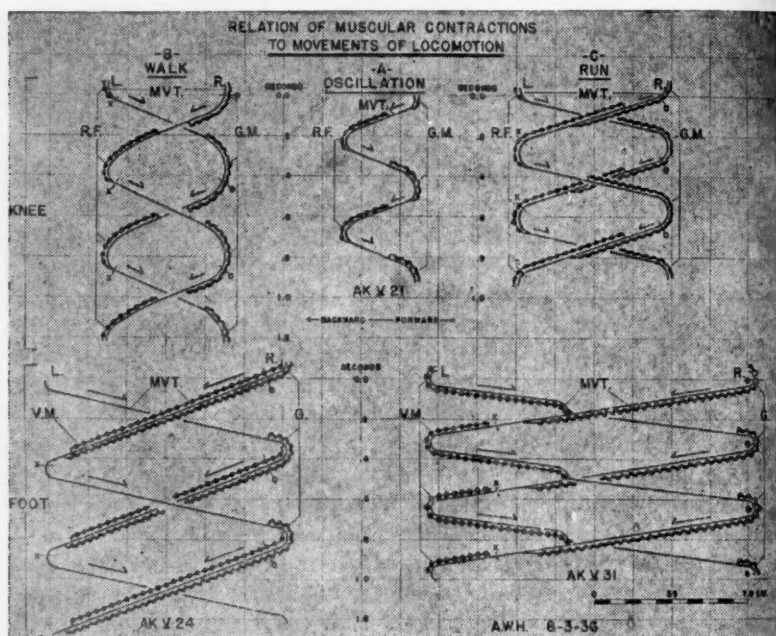


FIGURE III. Experimental data was recorded only from the right limb. In each case readings from a number of cycles on one record were averaged to give an average cycle which was used in making the drawing. In order to show bilateral relations, the average cycle from the right limb in walking and running was duplicated one half cycle off-phase and labeled "Left."

Time is on a vertical axis.

Mvt.—movement.

R.—right.

L.—left.

R.F.—rectus femoris contraction.

G.M.—gluteus maximus contraction.

V.M.—vastus medialis contraction.

G.—gastrocnemius contraction.

AK V 21, 24, 31—record identification numbers.

Scale—actual excursion of the movement.

The foot struck the tread at the point marked O.

The toe left the tread at the point marked X.

This is the result of more intense contractions and of more effective coordinations.

Trained runners use dynamic balance. They use the momentum of well directed, ballistic movements of all four limbs to keep the body in balance. The untrained runners use the mass of their arms as ballast, which they shift to meet the repercussion of poorly directed leg movements. The habit of running with all four limbs and of replacing the tense, awkward, ballast-shifting movements of arms with the high-speed, ballistic movements of the swinging arms is a sign of the trained runner.

In running, the backward moving limb serves as a support from which the ballistic movements of the opposite limb can be thrown. This can be done as effectively with the whole foot on the ground as with

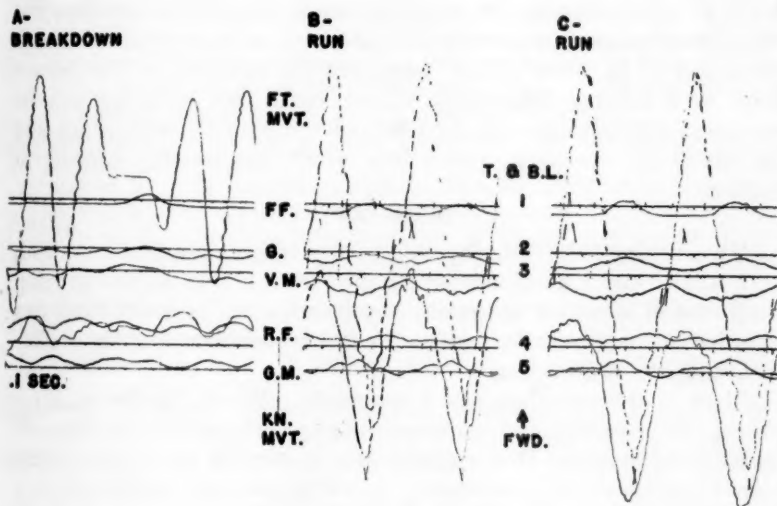


FIGURE IV. (A) Breakdown of a reciprocal ballistic movement of the lower limb. The tracing of the foot movement loses amplitude as the rate increases, stops as the contraction of one driving muscle overlaps that of the other, and then starts again at a slower rate. (B) Runner taking $4\frac{1}{2}$ steps a second. (C) Runner taking 3 steps a second. The excursion of the foot is considerably less in B than in C.

Ft. Mvt.—foot movement.

Kn. Mvt.—knee movement.

T. and B.L., 1, 2, 3, 4, 5.—Timer (.1 sec.) and base line marker.

FF.—footfall.

G.—gastrocnemius contraction.

V.M.—vastus medialis contraction.

R.F.—rectus femoris contraction.

G.M.—gluteus maximus contraction.

Original kymograph records 30 x 64 cm.

the foot extended. Distance runners should light on the heel with the foot limp and leave the foot flat on the ground as the body passes over it. Nurmi was a famous example of this. There is ample photographic evidence of it, and it was evident in this laboratory study. Inexperienced runners starting cross country often drop back because of soreness in the calf of the leg. This soreness disappears when they are taught to run flat-footed, since they are no longer overworking the calf muscle.

Bock, Vancaulaert, and others (1928)⁸ have pointed out that training may make some difference in the general metabolism, but that alone cannot account for the difference between trained and untrained runners. The ability to withstand fatigue is the result of loose, ballistic running movements and of a posture arising from well directed, reciprocal ballistic movements of the arms and legs. In this way there is no waste of energy through the cocontraction of antagonistic muscles, and the driving muscles are actually relaxed during about two-thirds of each movement cycle. Fenn (1930)⁹ computed the efficiency of the human body as a running machine at 23 per cent. This efficiency can be explained satisfactorily only in terms of the ballistic movements and the essentially isometric contractions which are actually present in running.

SUMMARY

The running habits of ten subjects, five trained and five untrained, were studied under conditions practically identical with normal running conditions. The action of certain key muscles of the lower limb was recorded and analyzed in relation to the movements of limb oscillation, walking, and running.

Most of the recording was kymographic. Muscle bulges were recorded pneumatically and movement was recorded with a thread-and-rubber-band system. This material was confirmed by oscillographic material in which the movements, muscle bulges, and action currents were all recorded simultaneously.

Reciprocal ballistic movements are used in walking and running. These are highly efficient because first, the ballistic strokes have long periods during which the limb moves by momentum; second, the movements are driven by essentially isometric contractions; third, wasteful cocontractions of antagonistic muscles are avoided; and last, the driving muscles are relaxed during the greater part of each movement cycle. The postural movements were also found to be substantially ballistic. An effort to push reciprocal ballistic movements beyond a certain rate results in a "breakdown" of the movement cycle.

Improvement in running is the result of increasing the length of stride rather than the rate of movement. Trained runners use dynamic balance, assisting the well directed, ballistic, leg movements with similar arm movements. Distance runners should light on the heel with

the gastrocnemius limp, and leave the foot flat on the ground as the body passes over it.

BIBLIOGRAPHY

1. Beaunis, H., "Recherches sur la contraction simultanée des muscles antagonistes," *Gaz. med. de Paris*, 56 (1885) 340; also *Arch. de Physiol. norm. et path.*, Ser. 5, 1 (1889) 64.
2. Bingham, W. Van Dyke, "Studies in Melody. Effects of Melodic Stimuli upon Muscular Movement," *Psy. Mon.*, 12:3 (1910) 44.
3. Bock, A. V., C. Vancaulaert, A. B. Dill, A. Fölling, L. M. Hurxthal, "Studies in Muscular Activity. III. Dynamical Changes Occurring in Man at Work," *Journ. Physiol.*, 66 (1928) 136-161.
4. Cooper, Sybil, and J. C. Eccles, "The Isometric Responses of Mammalian Muscles," *Journ. Physiol.*, 69 (1930) 377-385.
5. Fenn, W. O., "Fractional and Kinetic Factors in the Work of Sprint Running," *Amer. Journ. Physiol.*, 92 (1930) 583-611.
6. Fenn, W. O., "Work against Gravity and Work Due to Velocity Changes in Running," *Amer. Journ. Physiol.*, 93 (1930) 433-462.
7. Fenn, W. O., H. Brody, A. Petrilli, "The Tension Developed by Human Muscles at Different Velocities of Shortening," *Amer. Journ. Physiol.*, 97 (1931) 1-14.
8. Fenn, W. O., and B. S. Marsh, "Muscular Forces at Different Speeds of Shortening," *Journ. Physiol.*, 85 (1935) 277-297.
9. Hartson, L. D., "Analysis of Skilled Movements," *The Personnel Journal*, 11: 1 (June 1932) 28-43.
10. Hill, A. V., "The Absolute Mechanical Efficiency of the Contraction of an Isolated Muscle," *Journ. Physiol.*, 46 (1913) 435-469.
11. Hill, A. V., "The Maximum Work and Mechanical Efficiency of Human Muscles and Their Most Economical Speed," *Journ. Physiol.*, 56 (1922) 19-41.
12. Hill, A. V., *Muscular Movements in Man*. (New York: McGraw-Hill Book Company, Inc., 1927).
13. Hudgins, C. V., and R. H. Stetson, "A Unit for Kymograph Recording," *Science*, 76 (July 15, 1932) 60.
14. Knoll, W., and T. Matthies, "Kinemat. Beweg.-Stud. Analyse und Synthese leichtathletische Würfe," *Schweiz. Med. Wschr.*, 2 (1931) 925-931.
15. Knoll, W., and W. Morenz, "Der sportliche Lauf als Vierfüßerbewegung," *Arb. Physiol.*, 5 (1932) 227-238.
16. Knoll, W., and B. Feeser, "Kinemat. Beweg.-Stud. VI Mitt. Beziehungen zwischen Körperschwerpunkt und Gleichgewicht," *Arb. Physiol.*, 8 (1934) 304-312.
17. Knoll, W., and K. H. Mock, "Kinemat. Beweg.-Stud. VII Mitt. Der Start zum Kurztreckenlauf," *Arb. Physiol.*, 8 (1934) 335-346.
18. Kreezer, G., and A. D. Glanville, "A Method for the Quantitative Analysis of Human Gait," *Journ. Genet. Psy.*, 50 (1937) 109-136.
19. Lumley, A. E., "Breathing Movements in Running," (Unpub. thesis, Oberlin College Library, 1931).
20. Richer, P., "Locomotion Humaine," *Traité de Physique Biologique* (D'Arsonval et autres), 1 (1901) 156.
21. Rieger, C., "Über Muskelzustände," *Zschr. f. psy. u. phys. d. S-org.*, 32 (1903) 384ff.
22. Stetson, R. H., "Rhythm and Rhyme," *Harvard Psyc. Studies*, 1; *Psy. Mon.*, 4 (1903) 413.
23. Stetson, R. H., "Motor Theory of Rhythm and Discrete Succession," *Psy. Rev.*, 12 (1905) 250ff.

- 24. Stetson, R. H., and H. D. Bouman, "The Coordination of Simple Skilled Movements," *Arch. Néerl. de Physiol. de l'h. et des anim.*, 20 (1935) 179-254.
25. Stetson, R. H., and C. V. Hudgins, "Function of Breathing Movements in the Mechanism of Speech," *Arch. Néerl. de phon. expér.*, 5 (1930) 6ff.
26. Stetson, R. H., and G. C. Throner, "Training for Flexible Posture and Relaxation Movements," *RESEARCH QUARTERLY*, 7: 1 (March 1936).
27. Stevens, H. C., and R. P. Metcalf, "The Decrement in Muscular Force with Increasing Speed of Shortening," *Amer. Journ. Physiol.*, 107 (1934) 568-576.
- 28. Wachholder, K., "Willkürliche Haltung u. Beweg. insbesondere im Lichte elektrophysiol. Untersuchungen," *Ergebn. d. Physiol.*, 26 (1928) 568-775.

The Physical Development of Students in the Bulgarian Gymnasiums

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THE medical observation of the physical development of the students in the Bulgarian gymnasiums is carried out by:

1. Anthropometric examinations done by the school doctor himself twice a year—at the beginning of the school year (in the second half of October) and at the end of the year (in the second half of June).

2. Medical examinations of all students once a year.

The results of these examinations are recorded on the health cards of the students. The data given in the present article are based on the students' health cards and refer to the 1936-37 academic year. Only data obtained by the examinations of students in the complete gymnasiums have been elaborated. The complete gymnasium course comprises the ages between 13-14 to 21-22.

CHANGES IN HEIGHT GROWTH

During the school year, the height growth progressed normally, as is seen in Table I. Of all boy students, 25,896 in number, 19,667 (or 75.95 per cent) have grown, while of all girl students, 15,189 in number, 8,767 (or 57.72 per cent) have grown. The percentage of girl students who have grown is smaller on account of the fact that as the girls develop physically more rapidly, their development takes place

TABLE I
CHANGES IN HEIGHT GROWTH

Age	Boy Students			Girl Students		
	Number examined	Grown Number	Per cent	Number examined	Grown Number	Per cent
13-14	478	454	94.98	445	379	85.17
14-15	3936	3744	95.12	2926	2396	81.89
15-16	5602	5207	92.95	3703	2577	69.59
16-17	5834	4745	81.33	3225	1651	51.19
17-18	4960	3375	68.04	2899	1158	39.94
18-19	2220	1165	52.48	1126	371	32.95
19-20	1211	500	41.29	504	142	28.17
20-21	745	230	30.87	178	49	27.53
21-22	910	247	27.14	183	44	24.04
Total	25896	19667	75.95	15189	8767	57.72

earlier than is the case with boys. Consequently, a considerable number of the girl students in the gymnasiums are already toward the end of their physical development.

Evidently the percentage of the girl and boy students who have grown varies with the different ages. With our age composition (gymnasium students) the greatest percentage growth, 95.12, was shown by the boy students during the fourteenth to fifteenth year, while the greatest percentage growth for girls, 87.67, took place during the thirteenth to fourteenth year. Both groups showed the least growth in the twenty-first to twenty-second year—27.14 per cent for boys and 24.04 per cent for the girls.

CHANGES IN WEIGHT

While during the school year the growth in height has progressed normally, the growth in weight shows considerable deviations.

Table II gives the percentages of the students who have grown in height and in weight.

TABLE II
PERCENTAGES OF STUDENTS GROWING IN HEIGHT AND WEIGHT

Age	Boy Students		Girl Students	
	Per cent of those who have grown: Height	Per cent of those who have grown: Weight	Per cent of those who have grown: Height	Per cent of those who have grown: Weight
13-14	94.98	88.52	85.17	51.2
14-15	95.12	81.32	81.89	40.32
15-16	92.95	71.55	69.59	27.11
16-17	81.33	61.26	51.19	16.03
17-18	68.04	46.9	39.94	12.54
18-19	52.48	35.1	32.95	11.59
19-20	41.29	29.83	28.17	11.18
20-21	30.87	28.3	27.53	18.03
21-22	27.14	27.99	24.04	13.45
Total	75.95	58.01	57.72	22.99

This table clearly indicates the great disproportion between the growth in height and in weight during the school year. *A considerable number of youths who have grown in height have not grown in weight, as would naturally have been expected.* This disproportion is specially striking with the girls. Thus, of all girl students, 57.72 per cent have grown in height, while only 22.95 per cent have increased their weight!

The fact that a considerable part of our girl and boy students have reduced rather than increased their weight during an age of very intensive growth, such as adolescence, is of particular importance. Thus, 31.43 per cent of all boy students and 76.2 per cent of all girl students have reduced their weight during the school year by 1.51-2.28 kgr. for the boys and 1.87-2.89 for the girls.

It is interesting to note that during this year, too, is repeated the same phenomenon which has been observed during the preceding years,

namely, that the percentage of those who have reduced in weight grows regularly and progressively with the age of the students. Diagrams 1 and 2 bring out this fact very clearly.

As is seen on the diagrams, the percentage of the boys at the age of 13-14 who have reduced is only 5.98, while for the boys at the age of 21-22 this percentage is 58.76. The corresponding figures for the

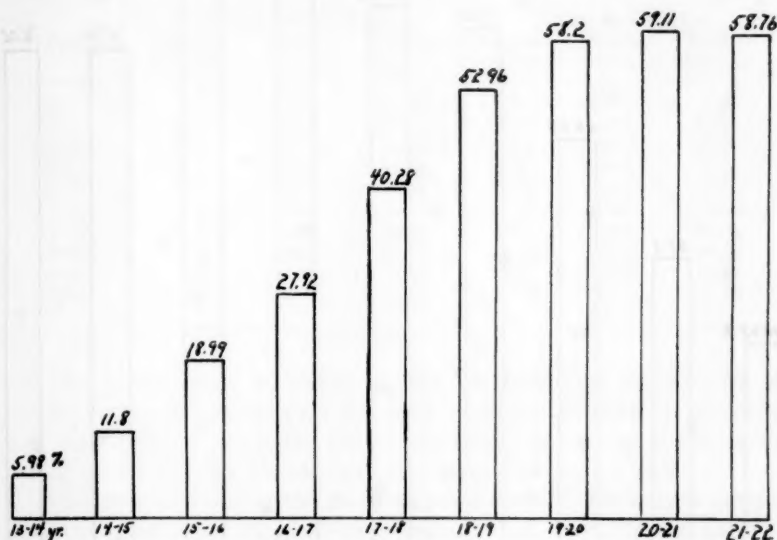


Diagram 1. Per cent of boys who have reduced in weight during the school year.

girls are 40.42 per cent and 83.53 per cent (for girls 18-19 years old).

This regularity is not hazardous. It is repeated every year and may be considered as a permanent phenomenon. It is worth noting the fact that the percentage of the girls who have reduced is much greater than is the case with the boys. This fact has focused attention in all previous observations.

CHANGES IN HEIGHT AND WEIGHT DURING THE VACATION

With a view to ascertain whether this reduction in weight of our gymnasium students is observed only during the academic year, the Ministry of Public Education has required the school doctors to file data for the physical development of the students during the vacations. The task envisaged, therefore, was to make a comparison between the last medical examination during the school year 1936-37 and the first medical examination in the beginning of the next school year, 1937-38. The period in between the two examinations is three months—July, August, and September.

The comparison of the height growth during the school year and the vacation (Tables III and IV) shows that the growth in height has been more intensive during the vacation period. Although the vacation period comprises three months and the school year nine months, 76.82 per cent of all boy students have grown during the vacation, while the

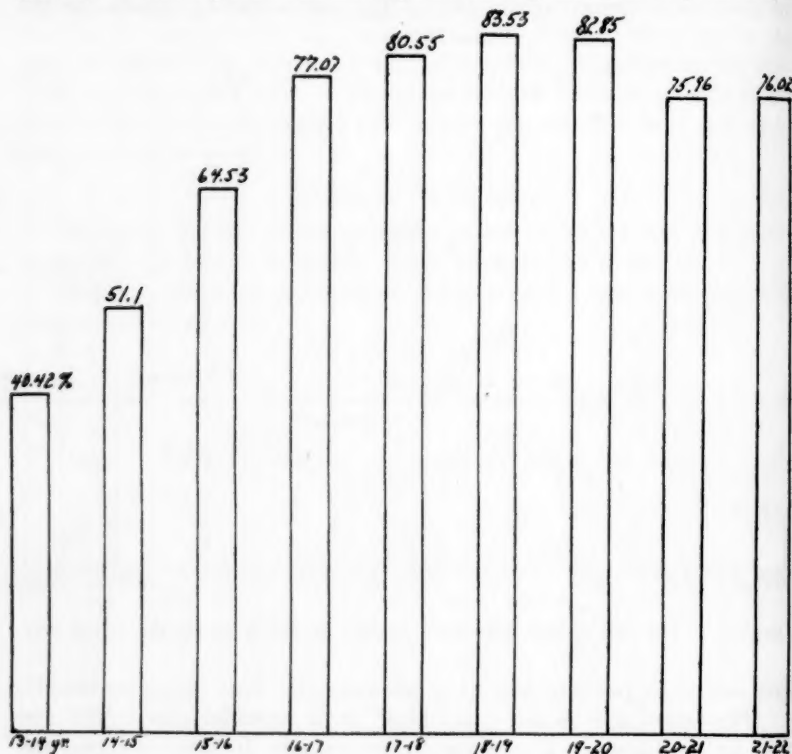


Diagram 2. Per cent of girls who have reduced in weight during the school year.

percentage for the school year is 75.95. It is true that the percentage (45.18) of the girls who have grown during the vacation is smaller than the corresponding figure (57.72) during the school year, but this does not imply that the growth processes of the girls have been less intensive during the vacation than during the academic year. Quite to the contrary, in view of the difference in the duration of the two periods compared, already pointed out above, it should be concluded that the height growth of the girls has been more intensive during the vacation.

The comparison between the school year and the vacation as regards the growth in weight is of particular interest. While during the

9 months of the school year 58.01 per cent of the boys and 22.99 per cent of the girls have grown in weight, the corresponding figures for the vacation are: 86.03 per cent for the boys and 89.96 per cent for the girls.

TABLE III
GROWTH IN HEIGHT OF BOY STUDENTS

Age	During the School Year			During the Vacation		
	Number Examined	Number Growing	Per Cent Growing	Number Examined	Number Growing	Per Cent Growing
13-14	478	454	94.98	62	60	96.77
14-15	3936	3744	95.12	2191	2087	95.25
15-16	5602	5207	92.95	5025	4590	91.34
16-17	5834	4745	81.33	5162	4223	81.81
17-18	4960	3375	68.04	4918	3345	68.02
18-19	2220	1165	52.48	2007	1194	59.49
19-20	1211	500	41.29	867	392	45.21
20-21	745	230	30.87	475	194	40.84
21-22	910	247	27.14	395	125	31.65
Total	25896	19667	75.95	21102	16210	76.82

The figures given in Tables V and VI show that the increase in weight during the school year has been roughly 1.42-3.22 for the boys and 1.45-2.31 for the girls; the corresponding figures for the vacation period are: 2.20-3.34 for the boys and 2.89-3.42 for the girls.

Consequently, during the three vacation months, not only a greater number of students increase their weight, but the increase itself is greater than the increase observed during the 9 months of the school year.

We have seen that not all youths who have grown in height have grown in weight (Table I).

Table III makes possible the comparison of the growth in height

TABLE IV
GROWTH IN HEIGHT OF GIRL STUDENTS

Age	During the School Year			During the Vacation		
	Number Examined	Number Growing	Per Cent Growing	Number Examined	Number Growing	Per Cent Growing
13-14	445	379	85.17	51	45	88.24
14-15	2926	2396	81.80	1944	1267	65.17
15-16	3703	2577	69.59	3698	1950	52.73
16-17	3225	1651	51.19	3153	1330	42.18
17-18	2899	1158	39.94	3226	1093	33.88
18-19	1126	371	32.95	878	226	25.74
19-20	504	142	28.17	233	62	26.61
20-21	178	49	27.53	84	21	25
21-22	183	44	24.04	68	19	26.61
Total	15189	8767	57.72	13267	5994	45.18

during the vacation with the growth in weight. It is clearly seen that during the vacation we have exactly the reverse relations than those observed during the school year, namely, the percentage of those who have increased their weight is greater than those who have grown in height.

Therefore, during the vacation period the growth in weight is

TABLE V
GROWTH IN WEIGHT OF BOY STUDENTS

Age	During the School Year				During the Vacation			
	Number Examined	Number Gaining	Per cent Gaining	Average kgr.	Number Examined	Number Gaining	Per cent Gaining	Average kgr.
Total	26637	15451	58.01		21136	18184	86.03	
13-14	418	370	88.52	3.22	58	52	89.66	3.34
14-15	3924	1191	91.32	2.75	2190	2055	93.84	3.28
15-16	5753	4116	71.55	2.31	5069	4666	92.05	3.2
16-17	5953	3647	61.66	2.31	5147	4481	87.06	3.18
17-18	5156	2418	46.9	2.1	4904	4050	82.59	2.84
18-19	2311	809	35.1	1.95	2033	1647	81.01	2.8
19-20	1284	383	29.89	1.6	865	643	74.34	2.62
20-21	834	236	28.3	1.76	475	336	70.74	2.2
21-22	1004	281	27.99	1.42	395	254	64.3	2.2

greater than the growth in height, while during the school year the reverse is true—the increase in weight lags behind the increase in height.

We are specially interested to know whether, during the vacation, a reduction in weight is observed similar to that noticed during the school year.

As we have seen, during the school year 31.43 per cent of the boys and 69.56 per cent of the girls have reduced. The corresponding fig-

TABLE VI
GROWTH IN WEIGHT OF GIRL STUDENTS

Age	During the School Year				During the Vacation			
	Number Examined	Number Gaining	Per Cent Gaining	Average kgr.	Number Examined	Number Gaining	Per Cent Gaining	Average kgr.
13-14	334	171	51.2	2.3	47	42	89.36	2.89
14-15	2681	1081	40.32	1.81	1873	1715	91.56	2.96
15-16	3769	1022	27.11	1.84	3518	3191	90.7	3.42
16-17	3175	509	16.03	1.77	3000	2706	90.2	3.15
17-18	2575	323	12.54	1.66	3106	2761	88.89	3.12
18-19	1208	140	11.59	1.71	888	778	87.61	3.4
19-20	519	58	11.18	1.59	244	217	88.93	3.26
20-21	183	33	18.03	1.45	91	75	82.42	3.03
21-22	171	23	13.45	2.05	80	62	77.5	3
Total	14615	3360	22.99		12767	11485	89.96	

ures during the vacation are 7.75 per cent for the boys and 5.92 per cent for the girls. During the vacation only those students who are in poor social environment reduce—those who have been sick, who have had hard physical labor, and a part of those who had to prepare make-up examinations.

From the above given data, one has the impression that during the vacation the student's body, left free to enjoy the open air and sunshine, gives vent to all the forces of growth usually inhibited during the school year and really flourishes.

TABLE VII
DURING THE VACATION

Age	Boy students		Girl students	
	Per cent who have grown in Height	Per cent who have grown in Weight	Per cent who have grown in Height	Per cent who have grown in Weight
13-14	96.77	89.66	88.24	89.36
14-15	95.25	93.84	65.17	91.56
15-16	91.34	92.05	52.73	90.7
16-17	81.81	87.06	42.18	90.2
17-18	68.02	82.59	33.888	88.89
18-19	59.49	81.01	25.74	87.61
19-20	45.21	74.34	26.61	88.93
20-21	40.84	70.74	25.	82.42
21-22	31.65	64.3	26.61	77.5
For all students	76.82	86.03	45.18	89.96

CHEST MEASUREMENT

The chest measurement is a very changeable measure, which is very difficult to ascertain exactly. Therefore, for statistical elaboration we have taken into consideration only the measure of maximum inhalation, which is easier to measure with greater accuracy. Still, the following figures should be interpreted with precaution.

During the school year 56.75 per cent of the boys and only 31.5 per cent of the girls have increased their chest measure. The corresponding figures for the vacation months are 75.17 per cent and 71.48 per cent respectively.

BODILY INDEX (Pignet)

The physical development of the students in our schools is measured by the bodily index of Pignet. This index comprises the three measures: height, weight, and chest measurement. The smaller this index is, within certain bounds, the better the physical development is considered to be. Inversely, the greater the index is, the poorer the physical development is considered to be. The great index usually points to a disproportion between height, on the one hand, and weight and chest measurement on the other hand. People who give such index have small chests and less weight than corresponds to their height.

This index varies with age. With the physical development and growth during the gymnasium period this index shows a progressive decline. Thus, for the 13- to 14-year-old students, who have "good" physical constitution, the index fluctuates between 39.5 and 35.5, while for the 20-year-old students it varies between 23.5 and 19.5. Therefore, a normally progressing development and growth should give a progressively declining index during that age.

Table VIII points out that in reality a considerable part of the boys and a still greater number of the girls show an increased bodily index during the academic year, which implies impaired physical development.

TABLE VIII

Age	Boy students						Girl students					
	Number examined	Increased Index		Decreased Index		No. exam- ined	Increased Index		Decreased Index			
		No.	Per cent	No.	Per cent		No.	Per cent	No.	Per cent		
13-14	479	233	48.64	190	39.67	307	190	61.89	105	34.2		
14-15	3971	2085	52.51	1552	39.08	2605	1677	64.38	812	31.17		
15-16	5744	2908	50.63	2326	40.49	3700	2462	66.54	1065	28.78		
16-17	5951	2933	49.28	2448	41.14	3424	2489	72.69	791	23.1		
17-18	5092	2595	50.96	2007	39.41	2776	2000	72.05	647	23.3		
18-19	2264	1251	55.26	781	34.5	1105	822	74.39	235	21.27		
19-20	1271	716	56.33	398	31.31	508	373	73.43	113	22.24		
20-21	810	451	55.68	256	31.6	181	136	75.14	37	20.44		
21-22	969	530	54.69	296	30.55	194	144	74.23	42	21.65		
Total	26651	13702	51.61	10254	38.62	14800	10293	69.55	3847	25.99		

At the end of the school year, 51.61 per cent of the boys and 69.55 per cent of the girls mark an increased bodily index, while only 38.62 per cent of the boys and 25.99 per cent of the girls give a diminished index. This increase of the bodily index, which is of a rather mass character, is due to the disproportion in the growth in height and weight which was pointed out above. The reduction in weight observed in a great number of our students and the insufficient increase in the chest measurement coupled with an uninterrupted growth in height lead to an increased bodily index. Most of the girls show greater reduction in weight, and, consequently, the increase of their bodily index assumes greater proportions.

During the school year, therefore, in 51.61 per cent of the boys and 69.55 per cent of the girls is observed a physical development which is characterized by comparatively great height, small weight, and narrow chest.

On the basis of the bodily index of Pignet, the physical development of the students in our schools is graded as "very poor," "poor," "average," "good," and "very good."

It is evident that with such an increase, of mass character, of the

bodily index during the school year, the percentage of the students with "very poor" and "poor" physical development will increase at the expense of the students with "good" and "very good" physical development.

The following table indicates the changes in the physical development during the school year.

As is seen from this table, in the beginning of the school year the percentage of the boy students with "very poor," "poor," and "average" physical development reached 38.64, while at the end of the academic year their percentage increased to 47.49. The corresponding figures for the girls are 42.15 and 59.95.

TABLE IX
Boys

Physical development	Number examined	Beginning of year		Number Examined	End of year	
		No.	Per cent		No.	Per cent
"Very poor," "poor," and "average"	18040	6863	38.04	17931	8515	47.49
"Good" and "very good"	18040	11177	61.96	17931	9416	52.51
GIRLS						
"Very poor," "poor," and "average"	12867	5424	42.15	12836	7695	59.95
"Good" and "very good"	12867	7443	57.85	12836	5141	40.05

This increase of the percentage of the students with poor physical development takes place, of course, to the detriment of those with "good" and "very good" bodily development. Thus, the percentage of the students with "good" and "very good" bodily development was in the beginning of the school year 61.96, while at the end of the year it fell to 52.51. The corresponding figures for the girls are 57.85 and 40.05 respectively.

CHANGES IN THE INDEX OF PIGNET DURING THE VACATION

In view of all this, it is of some interest to consider the changes in the bodily index during the vacation months.

During the vacation months, 72.29 per cent of the boys and 78.28 per cent of the girls show a decrease of the index, and only 21.12 per cent of the boys and 18.62 per cent of the girls show an increased index.

This indicates that during the vacation months the physical development, contrary to what happens during the school year, improves and tends to attain a more harmonic correlation of height, weight, and chest measurement.

It is to be expected, therefore, that during the vacation the percentage of the students with "very poor" and "poor" physical develop-

ment, will increase, while the percentage of the students with "poor" and "very poor" bodily growth will decrease.

Indeed, the percentage of the boys with "very poor" and "poor" physical development, which was as high as 46.49, was reduced during the vacation to 39.64. The corresponding figures for the girls are 57.27 and 43.77, respectively. Meanwhile, of course, the percentage of the boys with "good" and "very good" physical development was raised from 53.51 to 60.36, while for the girls the increase was even greater, namely, from 42.73 to 56.23.

TABLE X

Age	Boy students						Girl students					
	No. ex- amined	Increased Index		Decreased Index			No. ex- amined	Increased Index		Decreased Index		
		No.	Per cent	No.	Per cent			No.	Per cent	No.	Per cent	
13-14	37	4	10.81	30	81.08		39	5	12.82	33	84.62	
14-15	2061	468	22.71	1470	71.32		1890	344	18.2	1476	78.1	
15-16	4735	899	18.99	3547	74.91		3616	706	19.52	2811	77.74	
16-17	4714	998	21.17	3446	73.1		3061	531	17.35	2430	79.38	
17-18	4679	969	20.71	3361	71.83		3154	601	19.06	2460	77.99	
18-19	1875	414	22.08	1327	70.77		828	164	19.81	638	77.05	
19-20	748	170	22.73	519	69.38		225	32	14.22	185	82.22	
20-21	391	103	26.34	256	65.47		82	18	21.95	59	71.95	
21-22	368	117	31.79	219	59.51		64	12	18.75	52	81.25	
Total	19608	4142	21.12	14175	72.29		12895	2401	18.62	10092	78.26	

TABLE XI

Boys					
Physical development	Number examined	End of year		Number examined	Beginning of year
		No.	Per cent		No. Per cent
"Very poor," "poor," and "average"	20118	9353	46.49	19987	7923 39.64
"Good" and "very good"	20118	10765	53.51	19987	12064 60.36
Girls					
"Very poor," "poor," and "average"	12164	6966	57.27	12418	5435 43.77
"Good" and "very good"	12164	5198	42.73	12418	6983 56.23

From what has been said already, we may draw the following conclusions:

During the school year the growth in weight and chest measurement is greatly retarded, even inhibited, while the growth in height manifests no deviations. This leads to a physical development characterized by comparatively great height, small weight, and narrow chest.

Quite to the contrary, during the vacation the growth in weight and chest measurement is more intensive and leaves behind the growth

in height. This leads to a normal correlation of height, weight, and chest measurement—to a well balanced and harmonic development.

The regular, and of mass character, deviation from the normal growth which has been observed, is repeated during every school year and impels the objective observer to seek its causes.

During the school year, therefore, we must admit the existence of certain causes which operate constantly on the mass of students and bring about the above described unfavorable deviations from the normal development and growth. These causes do not operate during the vacation.

Some very accurate investigations have shown beyond any doubt that during the summer months the growth proceeds at a faster pace than during the winter months, when it is retarded (F. Dafner, *Das Wachstum des Menschen*, 1902).

In the light of these investigations, the intensive growth during the summer vacation months, which we have observed, appears to be normal. It remains only to be seen whether the inhibited growth in weight during the school year could be explained by seasonal fluctuations of growth, by the retarded development during the winter months.

Our observations, however, reveal not only a retarded growth, but a very negative intervention with the processes of growth, which leads even to reduction in weight.

The fact that the height growth during the school year shows no deviations does not imply that the existence of such negative influences is not admissible. Because, it may now be considered as proved beyond doubt that the growth in height may continue even when the growing organism is starving and is reducing in weight.

Besides that, in the period between the two examinations during the school year are included months which belong to seasons during which the growth processes take place more intensively.

On account of all these considerations, the mass reduction in weight observed during the school year cannot be explained by the seasonal growth fluctuations.

Therefore, the reasons for the unfavorable physical development during the school year should be sought in the school life itself.

On several occasions previously, I have had the opportunity to stress the point that prolonged and intensive mental activity, in a sitting position (five hours in the morning), in a stuffy schoolroom, reduces greatly the vital processes of the cells and particularly of the muscles. The muscular tissues represent about 40 per cent of the weight of the body. A good muscular condition is essential to good health. The progress of science shows the ever increasing importance of the muscular system. We know now that it is not just the main factor in our locomotion and a force that keeps the various parts of the skeleton in correct position. It is the muscular system, in fact, which rules the

metabolism of our body. Even when the body is in repose, 60 per cent of the energy of the organism is spent out within the muscular system. During physical activity, when the muscles are in motion, this percentage reaches and surpasses 90!

It is evident that the condition of the muscular system is the factor which determines the quantity of the food and its utilization by the organism. The smaller the muscular activity is, the less intensive the vital cell processes are and, consequently, the smaller the quantity of the food received by the organism.

During the school year the students, in the pursuit of their studies, spent almost the whole day in a sitting position, in which the muscular system is inactive and important organs and systems are in a position very unfavorable to their proper functioning. This is the case with the blood circulation, respiration, and the digestive system. In addition to that, the school environment is, in most cases, extremely unhygienic! The reduced activity of the muscular system—the heaviest organic matter of the human body—leads inevitably to a lowering of the vital processes of the organism and especially of the nutritive processes of the body. This in turn brings about a loss of appetite, which is a very common phenomenon among the students. And last but not least, the very inadequate nourishment of a large part of our students, especially of those who come from neighboring villages, contributes to the reduction in weight which has been observed.

In view of all that has been said, it is evident that this unfavorable phenomenon is a logical consequence of the conditions of school life itself.

The fact that girls reduce more comes to support this explanation, because it is well known that girls are more studious and, as a rule—especially in this country—lead a very inactive physical life and overwork themselves mentally.

The curious phenomenon that the percentage of the students who have reduced grows regularly and progressively with age is explained by the fact that the intensity of the growth processes vary with age. They are most intensive among the students of 13-14, 14-15, 15-16 years of age and are almost extinguished among the students of 21-22 years.

It is evident, therefore, that the same operating causes will produce changes different in intensity. These changes will be least in cases where to the detrimental external influences are opposed intensive internal forces of growth, and, inversely, these changes will be greatest in cases where to the detrimental external influences are opposed already extinguished forces of growth. In our case, therefore, the external influences are manifested with various degrees of intensity depending on the degree of internal fitness of the organism to growth.

The school requirements, with which the students have to cope,

impose on the conscientious student a severe regimen of mental activity with almost complete physical inaction. This is due to the overcrowded curriculum, on the one hand, and to the utter neglect of physical development on the other hand.

The fact that the curriculum of our gymnasiums is overcrowded has been ascertained on many occasions by the various teachers' councils.

These opinions have been expressed by the Educational Committee as follows:

"The teachers note that many of the school disciplines contain enormous material, which hinders the normal study of the really essential matter and overtires the students, both mentally and physically.

"All this is detrimental to the healthy and normal material and formal education of the students. Consequently, the material of the school curriculum should be reduced." (A report of the Educational Committee for the 1929-1930 academic year in *Teachers' Review*, No. 6, 1931). The school principals in their conference held in Sofia on January 12, 1931, expressed the following opinion on the subject: "In view of the fact that the school curriculum is overcrowded, it is imperative to revise it thoroughly" (A report of the Educational Committee for the 1930-1931 academic year, *Teachers' Review*, No. 5, 1932).

And last, but not least, greater attention should be given to the problem of the methodological side of the teaching process itself. The mental activity which is characterized by passive memorization, learning by heart the "assigned" lesson, takes more time, requires greater effort and consumes greater psycho-physical energy. Such mental activity leads usually to the already described phenomenon of physical decline. On the contrary, the mental activity which is based on the student's active participation in the learning process may be characterized, from the point of view of mental hygiene, as natural and, consequently, hygienic. Not mechanic, but logic, associative learning is the fundamental principle on which healthy mental activity should be based. And this could be achieved only by modern methods of active learning. In this respect our gymnasiums, with a few exceptions only, lag behind our elementary schools and pro-gymnasiums.

Besides being overcrowded, the curriculum of our schools has another setback, namely, it aims exclusively at mental training to the utter neglect of the body and its development. On the same subject, comparing the educator with the gardener, Spencer writes: "Although he looks at the flower itself as something to which everything else is subjected, the gardener knows that the leaves and the roots are of great importance because the whole development of the flower depends on them. He gives all his attention to the plant so as to have the flower." And, further on, he writes: "Here we see clearly the mistake

of our educational system—it neglects the plant, thinking only of the flower.”

It is true that in our school programs, physical education figures as one of the compulsory subjects. The fact that during the school year we note physical decline on such a scale shows that the school physical training does not fulfill its aims. What are the reasons for that?

First and foremost, we must make it clear that it is impossible to neutralize all school harms by a physical education which is practiced twice a week for an hour. In addition to that, these two hours for physical training are not fully utilized, because “gymnastics” is treated as a “technical” subject of no importance, and quite often they are used for other purposes (lectures, or are given to teachers who are late with their examinations, etc.).

During the school year the organism of the students suffers various changes which bring about physical decline. Therefore, the danger that the final result—the body of the grown-up person will bear the stamp of the harmful effects of school life and, consequently, will show a lowered capacity for sustained effort and less resisting forces to external evil influences—is eminent. Our gymnasiums, aiming exclusively at high mental achievements by the students, neglect their physical training and development. It is high time that the school, in accordance with modern knowledge and experience, coordinate mental and physical training in such a manner, as to achieve, as a result of well-balanced training of body and mind, a complete and harmonic educational product—well-developed mind in a healthy body.

Studies in the Physiology of Activity: III. On Certain Reactions of College Women Following Participation in Three-Court Basketball

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IN 1936, an investigation of certain physiological reactions of college women to participation in two-court basketball was reported.¹ The reactions studied included respiratory rate and metabolism, pulse rate, systolic and diastolic pressures. The present study deals with the effect upon these same physiological functions of participation in the three-division game. The observations here reported were made during the spring semester of 1936.

PROCEDURE

With one exception, the experimental procedure of the first study was duplicated as exactly as possible in the second. The same subjects were used, observations were made at the same time of day* under the same environmental conditions, all practice and tournament play was similarly organized under the same coaches, the level of skill of the whole group was of a similar order. In the determination of respiratory metabolism, the subject was equipped with a half-mask instead of with the mouth piece and nose clip used in the earlier study. The effects of this change were less discomfort for the subject, an increase of about five seconds in the time elapsing between cessation of play and connection of the subject with the apparatus, and a slight increase in the dead space of the apparatus.

In addition it must be noted that, although all of the subjects were of course qualified by the University physician for unlimited activity throughout the season, one subject (X) had been under observation at the University Health Service during a part of the preceding semester and had been for a short time restricted in her participation in vigorous activity. This subject also had had a mild case of influenza shortly before the beginning of the basketball season.

A record of the participation of the subject in the game, including

¹ P. Hodgson, "Studies in the Physiology of Activity: II: On Certain Reactions of College Women following Participation in Two-Court Basketball," *RESEARCH QUARTERLY*, 7:2 (May 1936) 45-55.

* One observation was made following a game played on Saturday morning.

the distance traveled and the duration of active play, was made by other investigators,² who have generously made a summary of their results available.

RESULTS AND DISCUSSION

The reactions of the four subjects to the game are presented in Tables Ia and Ib.

Total oxygen debt, expressed in liters per kilogram of body weight, varied from .025 to .086. The values for the subjects playing in the forward position were higher than for those playing guard. The second highest value (.082) was obtained for a player in the center position, as was the lowest value (.025). This low value was obtained following a game which in the judgment of all observers was not "typical." The return of the rate of oxygen consumption to within 5 per cent of the pre-exercise level, required from fifteen to over sixty minutes.

The rise in systolic pressure measured within one minute after cessation of play, ranged from twenty-seven to sixty-five mm. Hg, duration of the recovery period being from three to fifty-four minutes. In the determination of diastolic pressure, both fourth and fifth phases were recorded in all except one case, when only the fourth phase was determined. The diastolic pressures, both phases, were in almost every instance lower immediately after the activity than during the pre-exercise resting period. The magnitude of the drop was quite variable and in every instance, greater for the fifth than for the fourth phase.

The increase in pulse rate, determined in the first minute of recovery, ranged from fifty to eighty-four beats per minute over the pre-exercise level. The duration of the recovery ranged from twenty-three to over sixty minutes, in eight out of twelve cases the pulse rate being high at the end of one hour.

COMPARISON OF TWO TYPES OF GAME

Any comparison of the reactions to the two types of game must be made with caution. It is recognized that no single reaction nor any combination of those studied is thoroughly acceptable as a valid criterion of the physiological demands of the activity upon the individual. It is possible that total oxygen debt is the most nearly valid of the respiratory, and duration of pulse rate recovery, of the circulatory effects studied. It is further recognized that the number of individuals studied and of observations made warrant conclusions of a tentative or suggestive nature only. Care was used in the selection of subjects and in the control of experimental conditions in order to eliminate or equalize as far as possible factors other than the game itself which would affect the physiological state of the individual. The possibility of significant variations in the "fitness" of the subjects, especially of subject X, from one season to the next is recognized.

² N. Miner, and A. Espenschade. (Unpublished data, 1936.)

TABLE Ia
RESPIRATORY REACTIONS FOLLOWING THREE-COURT BASKETBALL

Subject Position	V		VIII		VII		X	
	G	G	G	C	F	F	C	F
Game	Prac-Tourna-Tourna-Prac-Tourna-Tourna-Tourna-Prac-Tourna-							
Time	After-After-After-After-After-After-After-After-							
	noon noon noon noon noon noon noon noon							
Average distance traveled (feet per minute)	185	133	177	155	210	155	244	232
Duration of active play (per cent of total playing time)	27	20	22	15	25	18	26	26
O ₂ debt (liters per kilogram)	.038	.036	.047	.034	.044	.045	.069	.056
Duration of recovery* (minutes)	40	20	45	50	35	40	60+	50
O ₂ of the first recovery period† (per cent of resting)	283	253	257	213	263	290	267	230
Pulmonary ventilation of first recovery period‡ (per cent of resting)	259	274	276	273	351	373	366	331
Ventilation index‡ of first recovery period‡	2.95	3.38	3.62	3.34	4.44	4.57	4.34	3.90
Maximum respiratory rate per minute	22	26	26	27	30	33	24	24
Maximum increase of respiratory rate per minute over resting	6	11	12	14	16	20	13	10

* O₂ consumption within 5 per cent of resting level.

† First recovery period of five minutes' duration.

‡ Ventilation Index = $\frac{\text{Pulmonary ventilation per minute}}{\text{Vital Capacity}}$

§ These figures are too low, due to delay in attaching nose clip.

TABLE Ib (Continued)

	4	7	18	3	54	50	18	10	14	15	5	7
Diastolic Pressure (mm Hg)	4th	5th	4th	5th	4th	5th	4th	5th	4th	5th	4th	5th
Minimum pressure	40	62	42	50	62	54	68	30	68	54	70	52
Minimum increase*	-20	-8	-20	-2	-10	-20	-24	-10	-23	-4	-8	-5
Increase at 6th minute of recovery	-11	+1	-3	+4	-2	-12	-18	0	-8	0	-7	+5
Increase at 60th minute of recovery	+2	+1	+7	+5	-1	+4	+2	-3	+3	+5	+4	+2
Increase at time of complete O ₂ recovery	-5	0	-2	+1	+4	0	-4	+1	-4	+5	+4	+1
Duration of recovery to ± 5 mm of Hg (minutes)	10	16	0	5	40	45	2	27	0	10	0	8
Pulse Rate	123	125	131	124	140	138	129	110	119	146	143	144
Maximum rate	+67	+71	+73	+68	+84	+84	+69	+50	+59	+80	+75	+76
Maximum increase*	+11	+24	+32	+42	+50	+53	+36	+31	+20	+24	+23	+40
Increase at 6th minute of recovery	+3	+10	+12	+4	+1	+9	+16	+14	+4	+16	+8	+28
Increase at 60th minute of recovery	+14	+20	+6	+8	+20	+37	†	+14	+11	†	+8	†
Increase at time of complete O ₂ recovery	49	60+	60+	33	46	60+	60+	60+	23	60+	60+	60+
Duration of recovery to ± 5 beats per minute												

* "Increase" is in relation to pre-exercise resting level.

† Exact time of O₂ recovery period not determined, exceeded 60 minutes.

It seems justifiable to assume, however, on the basis of both theory and experiment, that the degree of displacement of the various physiological functions from the resting pre-exercise level and the duration of the recovery period are indicative of the physiological demand made upon the individual by the activity. The assumption seems warranted also that, for the subjects used, a comparison of the responses of the same individual to the two types of game is a reasonably sound basis for evaluating the relative demands of the two games upon the participants. It is on the basis of these assumptions, and with full awareness of the inadequacies discussed above, that the following analysis is offered.

Inspection of Tables IIa and IIb in the first study and of Tables Ia and Ib in this study shows that variations in reaction within one type of game are as great as or greater than those between the two types.

Averages of the degree of displacement and the duration of the recovery period for the functions observed were computed for each subject, for each type of game, and for the positions of forward and guard (only a single observation on each of three subjects playing the center position was made). These averages were then ranked, those indicative of greater physiological demand being assigned the smaller rank number.

An analysis of each player's response is given in Table II. The rank order is consistent for only one subject (V) and indicates a greater demand in the three-division than in the two-division game. When the ranks for the various criteria are combined, for each of the

TABLE II
RANK ORDER* OF RESPONSE OF EACH PLAYER FOR EACH POSITION PLAYED

Subject	V	VIII	VII	X
Rank Order	All Respiratory Reactions			
1	G ₃	G ₃	F ₂	C ₃
2	G ₂	G ₂	C ₃	F ₂
3	...	G ₂	F ₂	F ₂
	Total O ₂ Debt			
1	G ₃	C ₃	F ₂	C ₃
2	G ₂	G ₃	F ₂	F ₂
3	...	G ₃	C ₃	F ₂
	All Circulatory Reactions			
1	G ₃	C ₃	F ₂	F ₂
2	G ₂	G ₂	F ₂	C ₃
3	...	G ₃	C ₃	F ₂
	Duration of Pulse Rate Recovery			
1	G ₃	G ₂	F ₂	F ₂ , C ₃ , F ₂
2	G ₂	G ₂ , C ₃	F ₂	...
3	...	...	C ₃	...
	All Respiratory plus All Circulatory Reactions			
1	G ₃	C ₃	F ₂	C ₃
2	G ₂	G ₂	F ₂	F ₂
3	...	G ₃	C ₃	F ₂

* The smaller numbers are indicative of greater physiological demand.

other three subjects for each position played, the differences are small and probably of no significance. The slight differences found are in favor of greater demand in the three-division game.

A comparison by positions played is given in Table III. Averages of the rank orders for all the criteria seem to indicate that the position of guard is less demanding than that of forward or center, the latter two being approximately the same.

TABLE III
RANK ORDER* OF RESPONSE OF ALL PLAYERS IN EACH POSITION

Reactions	Position and Type of Game				
	F ₁	F ₂	G ₁	G ₂	C ₁
All Respiratory	3	1	5	4	2
Total Oxygen debt	3	1	4.5	4.5	2
All Circulatory	1	5	4	2.5	2.5
Duration of pulse rate recovery	2	1	4	5	3
All respiratory and all circulatory	1	3	5	4	2
Average	2	2.2	4.5	5	2.3

* The smaller rank is indicative of greater physiological demand.

A comparison of the two types of game is given in Table IV. It is obvious that on the basis of the criteria used, there is practically no difference between the two games.

TABLE IV
RANK ORDER* OF RESPONSE IN TWO TYPES OF GAME

Reactions	Game	
	Two-Division	Three-Division
All respiratory	2	1
Total oxygen debt	2	1
All circulatory	1	2
Duration of pulse-rate recovery	1.5	1.5
All respiratory and all circulatory	1.5	1.5
Average	1.6	1.4

* The smaller rank is indicative of greater physiological demand.

SUMMARY

Observations were made upon four college women during a recovery period of sixty minutes following participation in practice and tournament games of three-division basketball.

There was marked but quite variable displacement of all the physiological functions studied.

Data for this study are compared with corresponding data on the same subjects, obtained under similar experimental conditions, following participation in the two-division game.

Variations in reaction within one type of game were greater than those between the two types. Analysis of the data shows no clear distinction between the two games with respect to physiological demand. The differences found tend to be in favor of the greater strenuousness of the three-division game, although the differences are very slight and probably of no significance. The position of guard seems to be less demanding than that of forward or center.

Acknowledgment.—The cooperation and interest of the Women's Athletic Association basketball players and managers are gratefully acknowledged. Special appreciation is expressed to those students who served as subjects, to Miss Anna Espenschade, Assistant Supervisor of Physical Education, and to the Misses Nancy Miner and Kathryn Heck, graduate students at the University of California for assistance in the study.

The Distance Traversed by Big Ten Basketball Players

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DURING the 1938-39 basketball season a study was made regarding the distances traversed by players in Big Ten basketball games, which was a continuation of earlier studies made on players representing other teams.¹

The data were obtained through the use of an electrical pursuit apparatus which provides for numerical registration of unit distances traversed. The piece of apparatus consists of a tin base, on which is etched a basketball court laid off to scale ($\frac{1}{2}''=1'$) wired in series with dry cell batteries, an electric impulse counter, and a small brass tracing wheel, 4" in circumference. Strips of insulating tape are located on the wheel at half-inch intervals so that rolling it along the metal floor makes and breaks the electric circuit each half inch. The impulse counter records these contacts, each one of which, with the calibration employed, represents a distance of two feet on the playing floor, which measured 94" x 50". To determine the distance traversed by a player, the experimenter follows the movements of the player on the small floor with the tracing wheel, from a position above the floor where a clear and unobstructed view of the playing area is available at all times.

GAMES STUDIED

Several games were clocked during the season, but data are recorded here for only three representative games. In game number 1, the Indiana center, W. Menke, was clocked in the Northwestern-Indiana game; in game number 2, an Indiana guard, Armstrong, was clocked in the Iowa-Indiana game; in game number 3, a Minnesota guard, Kundla, was clocked in the Minnesota-Indiana game. These games were all played in the Indiana University field house at Bloomington.

DISTANCES RECORDED

Table I indicates the distances traversed by the players on offense and defense, and for the entire game. In a previous study,² it was

¹ L. L. Messersmith and M. S. Corey, "Distance Traversed by a Basketball Player," *RESEARCH QUARTERLY*, II (May 1931).

² Paul J. Fay and Lloyd L. Messersmith, "The Effect of Rule Changes Upon the Distance Traversed by Basketball Players," *RESEARCH QUARTERLY*, IX (May 1938).

found that the distances traversed by players representing secondary college teams in Indiana ranged from 3.87 to 3.97 miles per game, indicating that players on secondary teams cover as much territory, per game, as the players on Big Ten teams. Distances traversed by high school players,³ however, were found to be considerably less, ranging from 2.65 to 3.20 miles per game.

TABLE I

Game No.	Distance traversed on offense		Distance traversed on defense		Distance for entire game	
	In Feet	In Miles	In Feet	In Miles	In Feet	In Miles
1	9888	1.87	10526	1.99	20414	3.87
2	9080	1.72	9190	1.74	18270	3.46
3	7646	1.45	12902	2.44	20548	3.89

SUMMARY

1. Players in Big Ten basketball games traveled from 3.46 to 3.89 miles per game, in games studied.
2. This distance is very similar to that traversed by players representing secondary college teams in Indiana.
3. The distance traversed by college players is considerably greater than the distance traversed by players in high school games.

³ Paul J. Fay and Lloyd L. Messersmith, "The Distance Traversed by College and High School Basketball Players and Effect of Rule Changes upon Distance Traversed in College Games," *Athletic Journal*, XVIII (May 1938).

The Assessment of Motor Abilities of College Women Through Objective Tests

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DURING the last few decades, education has been endeavoring to evaluate objectively the capacities of students and to classify them into more homogeneous groups than could otherwise be done. This is a direct outgrowth of the principle of individualization in modern education and the basis on which the individual's needs are approached. The same trend has been shown in the field of physical education, but with less satisfying results.

The problem of the evaluation of the student's ability in physical skills is indeed a pertinent one when considering the college freshman. She arrives as a total stranger, and in the course of a few brief contacts made through physical examination and conference, the physical education teacher is expected to advise her so that she will be happily placed in a group where she can participate fairly but with a challenge to her ability; so that she will receive the maximum benefit from time spent; and so that by the end of the required period she will have reached at least the minimum standards expected of all.

The individual differences of the college freshman are of two kinds. The first is that of her innate capacity, or her potentialities for acquiring various skills. The second type of difference is the wide variation of previous training and experience in motor activities. This is perhaps even greater than the first. A knowledge of both of these factors is essential to the most effective teaching.

A study of the literature reveals comparatively little material on evaluation of skills and grouping at the college level, particularly for women. The studies which have been published center around these problems: general motor ability, specific motor skills, and classification devices on the elementary and high school levels. None of the work will be discussed here, and mention only is made of that for college women. Collins and Howe,^{2*} Garfiel,³ Wayman,¹⁰ Alden,¹ Halsey,⁷ and Humiston⁸ report tests or batteries used for measurement of

This paper is a summary of a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, in the Graduate College, State University of Iowa, 1937.

* Refer to numbered Bibliography at end of article.

various aspects of general ability. Achievement scales have been presented by Mitchell¹⁷ and Cozens and Cubberly⁸ in track events, by Hyde⁹ in archery, and by Driftmier⁵ in strength tests.

A careful survey of the studies pertaining to the measurement of ability and classification of students leads to the following conclusions:

1. While many studies have been made, few have been applied directly to college women.
2. Many types of tests have been recommended recently which appear worthy of experimentation.
3. The most successful tests for classification represent a composite of skills.
4. Certain unities probably exist within the more general ability.
5. The prevalence of achievement norms at all ages indicates that much of the evaluation of student ability is in terms of absolute accomplishment rather than potentialities of accomplishment.

THE PROBLEM

It is the purpose of this study to find some means or device for evaluating the capacities and skills of the college freshman woman immediately upon entering college. The device should enable the physical education staff to place students wisely in classes and to organize and teach these classes better. This study deals only with those women who have been assigned to a normal activity program on the basis of the medical examination.

PROCEDURE

An extensive survey of literature, as summarized above, was made, and test material in use by other state universities was collected. This revealed the phases of the problem which had not been touched, and suggestions for new approaches were also found. The responses from the departments of physical education in other universities indicated that all were facing the same need.

The preliminary study also included the construction of an obstacle race. The items included in this race were selected by experimentation as described in the Appendix.

It was decided to use both subjective and objective measures as criteria by which to evaluate the tests. The subjective rating was made by the writer and three members of the physical education class to which the student belonged. The students making the ratings were selected because of their interest in class activities, their understanding of good performance, and their apparent keenness of observation and appreciation of the performance of others.

The ratings were made on the estimate of innate capacity and ability to learn as shown by class activity. The students making ratings were given three weeks in which to observe members of the class and rate them. The writer had known most of the subjects for about

four months. The final rating was the sum of that given by the writer and the median of those given by the students. There was an r of .67 between student and teacher rating.

The second criterion was a complete score, the items of which were selected to represent as wide a variety of sport skills as possible. They are basket shooting, ball toss, repeated passes, sand bag distance throw, sand bag accuracy throw, batting, kicking, catching, and catch and throw.* These tests are typical of the skills involved in the more common sports; some were familiar to the subjects and some were not. A catapult was used for the catching events in order to make them uniform and to make it possible to time the tests. A T-scale was prepared for each of the events and the average T-score for the nine items was known as the sports criterion.

The third criterion was a simpler achievement score, total points. This was derived from three fundamental activities—running, jumping and throwing—and combined according to McCloy.¹³

Later a composite criterion was evolved from these three. It will be described later and will be known as criterion IV.

The tests selected for experimentation were chosen on the basis of validity and reliability of the item in previous studies or in the preliminary investigation. The recent work of Kistler¹² on high school boys was also used as a guide in the selection of types of data desirable.

Practically all the items were events on which the subjects had not had previous training, and performance of which did not depend directly upon past experience. The tests selected represent, in general, strength, motor educability and ability, and skill. Two other factors which seemed desirable, personality and rhythmic ability, were discarded because of lack of techniques available with which to measure them. There were two original tests in the list, the shuttle and obstacle races.

It was hoped that the final battery selected would be suitable to administer as part of the physical examination at the beginning of a school year. Therefore, any test requiring a considerable amount of practice on the test itself was omitted.

The tests were given during the regular physical education class periods. All the subjects were freshman students in various sections of the freshman required course at the University of Iowa. Complete data were collected on 155 students.

Each of the test items and derived indices and each of the items included in the criteria, a total of thirty-five items, were then correlated with each of the three criteria and with every other item. The tests were then ranked according to their correlation with each of the three criteria. The ranking for the twenty highest items is shown in Table I.

The tests used and other measures derived from these data are

* See the Appendix for a description of the tests.

TABLE I
RANKING OF TWENTY ITEMS CORRELATING HIGHEST WITH THE CRITERIA

Rating	Sports Criterion		Total Points		Criterion IV		
G.M.C.	.5743	*Ball toss	.7342	†G.M.A.Q.	.8347	Basketball throw	.7809
Total points	.5563	*Catch and throw	.7190	*Broad jump	.7938	G.M.A.Q.	.7601
Johnson test	.5369	*Sand bag distance	.6826	*Basketball throw	.7883	Broad jump	.6630
Obstacle race	.5356	Basket ball throw	.6823	*Dash	.7108	Sargent jump	.6410
Sports criterion	.5256	Total points	.6799	Sports criterion	.6799	Sand bag distance	.6235
Brace test	.4921	*Catching	.6343	Obstacle race	.6529	Ball toss	.6230
Broad jump	.4807	*Passes	.6180	Sand bag distance	.6124	Dash	.6174
Sargent jump	.4639	*Basket shooting	.5988	Dodge run	.5823	G.M.C.	.5961
G.M.A.Q.	.4457	*Sand bag accuracy	.5884	Ball toss	.5765	Obstacle race	.5823
Ball toss	.4262	G.M.A.Q.	.5858	G.M.C.	.5663	Repeated passes	.5388
Dodge run	.4256	Obstacle race	.5807	Sargent jump	.5628	Basket shooting	.5294
Shuttle race	.4212	Dodge run	.5271	Rating	.5563	Brace test	.4860
Basketball throw	.4191	Rating	.5256	Shuttle race	.5465	Bass balance test	.4333
Dash	.4141	Side step	.5027	Passes	.4714	P.F.I.	.4309
Catch and throw	.4097	Broad jump	.4658	Dipping	.4621	Sand bag accuracy	.4199
Passes	.3852	Shuttle race	.4532	P.F.I.	.4501	Shuttle race	.3871
Sand bag distance	.3826	*Batting	.4473	Side step	.4357	Johnson test	.3528
Bass balance test	.3661	Dash	.4362	Johnson test	.4301	Dodge run	.3520
Dipping	.3649	Sargent jump	.3769	Catch and throw	.4279	Strength Index	.3293
Chinning	.3458	*Kicking	.3713	Strength Index	.4122	Kicking	.3142

* is part of the criterion.
† is derived from the criterion.

classified according to their general characteristics as being primarily (1) related to strength, or (2) related to general ability or some specific factor in general ability, or (3) related to achievement in previously learned activities.

The best items of each type were retained. The strength items had very low correlations with all three of the criteria. Consequently they were all dropped from further consideration with the exception of the P. F. I. and the Strength Index. In the second group, those items related to general ability, the Burpee test was dropped as it did not appear in the upper twenty with any of the criteria. All the other items in this group were retained, though some of them were low. In the third group all the items were retained, as they ranked in most cases in the upper ten with each criterion.

This left a total of thirteen items. The three criteria were then combined by multiple correlation with each of these thirteen items and also with each of the nine making up the sports criterion. On the assumption that a composite of the abilities represented by each of the criteria would give a better measure of general ability than would any one of the three, the fourth criterion was evolved.* Criterion IV = .0139 total points + .1506 sports criterion — .4285 rating.

Using this formula, criterion IV was computed for each of the 155 subjects. Then the correlation was made between this criterion and each of the 24 items. These are ranked in Table I.

The final step in the procedure consisted of selecting and combining items which would give the best results in evaluating ability and in classifying students. It was decided to divide the problem, i.e., to secure a device for measuring ability in sports, and another for measuring general ability. The criterion used for the first was the sports criterion; for the latter, criterion IV.

* The averages of the weightings of $Beta_1$, $Beta_2$, and $Beta_3$ for the 24 correlations were obtained. They were as follows:

$$B_1 \text{ (rating)} = .1765$$

$$B_2 \text{ (sports criterion)} = .2650$$

$$B_3 \text{ (total points)} = .2765$$

This mean was used in computing the equation.

$$\text{Criterion IV} = \left\{ (B_1 \frac{\sigma_0}{\sigma_1}) X_1 + (B_2 \frac{\sigma_0}{\sigma_2}) X_2 + (B_3 \frac{\sigma_0}{\sigma_3}) X_3 \right\}$$

where

B_1, B_2, B_3 = mean of the Beta weightings

σ_0 = S.D. of new criterion (arbitrarily selected)

σ_1 = S.D. of rating distribution

σ_2 = S.D. of sports criterion

σ_3 = S.D. of total points

X_1 = rating

X_2 = sports criterion

X_3 = total points

DISCUSSION OF DATA

A study of the twenty highest ranking items with each of the three preliminary criteria reveals eight facts which seem significant. These will each be discussed.

1. The correlations with rating are, as a whole, much lower than those with the other three criteria. This is true even after eliminating from the sports criterion and total points those items which constitute them or are derived from them. This is to be expected since the rating is purely subjective. These correlations, though not high, are considered satisfactory with such a criterion.

2. The highest ten events with rating include all those previously set forth as measures of ability or performance, namely, General Motor Capacity score, Johnson test, Brace test, Sargent jump and General Motor Ability Quotient. In this list will also be found the obstacle race which was devised for the same purpose. The only possible exception is the dodge run, which is ranked as eleventh but has practically the same correlation as the tenth. The other two criteria originally selected, sports criterion and total points, rank second and fifth respectively. These facts would indicate that the results are in conformity with previous investigations in the use of these and similar tests, and that these criteria rank favorably with other generally accepted measures.

3. The items constituting the sports criterion give spuriously high correlations. Batting and kicking are the lowest, probably because they involve activities least familiar to the subjects. Care must be taken in interpreting these correlations since they are a part of the criterion.

4. Aside from those items which make up the sports criterion and those which are of essentially the same nature, the next highest tests are the obstacle race, dodge run, and side step. These are all similar in skills involved and would indicate a fair measure of sports ability.

5. Total points represents primarily achievement, but aside from those items of which it is composed, the obstacle race gives the highest correlation, and the dodge run and G.M.C. are next. This compares favorably with their placement on the other criteria.

6. Total points is the only one of the criteria with which the strength items show any relationship. This appears logical in analyzing the criteria subjectively for the amount of strength necessary. In all the criteria the dominant factor is skill, presupposing a certain amount of strength as necessary to performance. In total points, coordination and agility are present but the strength available to project the body or ball through space is much more important.

7. The relative ranking of the events is determined to a large extent by the fact that the items making up the various criteria are included in the lists. What appears to be of greater significance than relative

ranking is the comparative uniformity of size of correlation of some of these items. An abbreviated table will demonstrate this fact more clearly.

Event	Rating	Sports Criterion	Total Points	Criterion IV
Obstacle	.54	.58	.65	.58
Johnson	.54	.30	.43	.35
Dodge run	.43	.53	.58	.35
Shuttle race	.42	.45	.55	.39
Brace	.49	.28	.38	.49
G.M.C.	.57	.36	.57	.59

These are all items purporting to measure general ability. Assuming that there is some difference in ability represented by the different criteria, then the fact that they show some consistency would help verify their worth as measures of general ability, at least over the range covered by the criteria.

8. The table of intercorrelations on these events reveals the fact that they are in many cases not highly related. This means that though none of the tests alone are highly valid in predicting ability, they should afford combinations which would raise very materially the relationship with the criteria.

Combinations of events by multiple correlation were made with the sports criterion and also with criterion IV. A study of these results indicates certain facts.

1. With either criterion there is a wide variety of combinations which will give relatively high coefficients of correlation. Of the fifty-two combinations made, the lowest is .71, more than half of them are above .80, and six are .90 or above. This would imply considerable choice of test items to meet local conditions of space, facilities, and time.

2. There are some two-item combinations which may be used almost as effectively as the three-item combinations. For example, the basketball throw and dash correlate .86 with criterion IV, while adding passes, broad jump, or Sargent will raise it to .90, .90, .91, respectively. A similar condition is true for the sports criterion. The three-item combination would be better, but if time were lacking a satisfactory estimate of ability could be made from the two tests.

3. Because of the high correlations obtained on the three items, it seemed improbable that any combination of more than three would give results high enough to make it worth administering. The only four-item combination which appeared logical from intercorrelations gave approximately the same size *R* as three items had given.

SELECTION OF A BATTERY FOR A PARTICULAR SITUATION

The selection of the two major criteria was made with the intention of meeting two different needs. The first is for the evaluation of ability and prediction of success in a sport program. The second is to meet the needs for a general program of activity including not only present achievement level but also facility of learning new skills.

In making the selection of items, the following factors have been considered: (1) validity or efficiency, (2) reliability, (3) time and effort required in administering and scoring, (4) space, i.e., indoor or outdoor, and equipment necessary, (5) the desirable supplementary information derived which may aid in planning courses and in teaching.

The importance of the first of these factors is obvious. The correlations, single and multiple, with each of the two major criteria will be accepted as indicative of the effectiveness of measurement.

In considering the reliability of the tests, the findings from other studies have been accepted on many of the items. In addition to these the reliability of certain events was determined by correlation between first and second trials, or between first and second halves of the test. Part of these were computed on a relatively few cases, some on all the 155 cases, and others by the addition of data from tests given freshmen the following year. Table II shows the number of subjects and the method used.

The remaining factors selected for consideration deal entirely with

TABLE II
RELIABILITY COEFFICIENTS DETERMINED IN THIS STUDY

Test Item	Coefficient of Reliability	Reliability by Spearman- Brown Prophecy for 2 times the length	Number of Subjects	S.D. of the Distribu- tion	Method 1st and 2d test	1st and 2d halves
Obstacle race	.910		69	3.25	x	
Sand bag distance	.906		48	12.02	x	
Sargent jump	.898	.946	247	5.06		x
Basketball throw	.890	.942	200	9.29		x
Broad jump	.794	.885	252	8.07		x
Sand bag accuracy	.771		161	7.00	x	
Passes	.623		188	2.72	x	
Dash	.618		54	2.05	x	
Ball toss	.605		159	6.80	x	
Bass balance	.592		158	26.28	x	
Basket shooting	.538		209	2.62	x	
Catching	.489	.656	159	1.99		x
Catch and throw	.488	.656	159	6.91		x
Shuttle race	.458		33	7.36	x	
Kicking	.442	.613	133	2.19		x
Batting	.360	.530	155	2.08		x
Burpee	.348		88	3.26	x	

conditions existing in various situations. The following discussion will, therefore, set up certain hypothetical situations and present the possible devices suited to each. Tables III and IV present the various combinations of tests.

Situation 1.—Desire for most effective evaluation and prediction of immediate performance in a sports program, equipment and time unlimited. The battery which appears to be best is composed of ball toss, catch and throw, and sand bag distance throw. This combination correlates .919 with the sports criterion. The second best combination is ball toss, basketball throw for distance, and sand bag throw for distance. It correlates .879 with the same criterion. The first requires special equipment, the second eliminates the use of the catapult.

Situation 2.—Same as 1, but with limited time or equipment available. The best battery is ball toss and sand bag distance throw, correlating .824 with the criterion; or ball toss and basketball throw for distance, with an r of .816; or, the ball toss alone gives an r of .734. If the floor is large enough for both tests to be administered at once, and assuming at least two subjects on the ball toss each time, one

TABLE III
CORRELATION OF TEST BATTERIES WITH SPORTS CRITERION

Battery	R
<i>Two-item Combinations</i>	
Ball toss, catch and throw .....	.8602
Catch and throw, sand bag distance .....	.8495
Ball toss, catching .....	.8395
Catch and throw, basketball throw .....	.8266
Ball toss, sand bag distance .....	.8241
Sand bag distance, catching .....	.8192
Ball toss, basketball throw .....	.8162
Catch and throw, side step .....	.7886
Catch and throw, dodge run .....	.7881
Basketball throw, sand bag accuracy .....	.7773
Ball toss, obstacle race .....	.7683
Ball toss, side step .....	.7532
Obstacle race, side step .....	.7528
Obstacle race, catching .....	.7520
Catching, side step .....	.7510
Obstacle race, sand bag distance .....	.7430
Obstacle race, sand bag accuracy .....	.7411
Basketball throw, side step .....	.7250
Obstacle race, basketball throw .....	.7250
<i>Three-item Combinations</i>	
Ball toss, catch and throw, sand bag distance .....	.9190
Ball toss, basketball throw, sand bag distance .....	.8789
Ball toss, sand bag accuracy, sand bag distance .....	.8684
Ball toss, basket shooting, sand bag distance .....	.8535
Obstacle race, side step, catch and throw .....	.8438
Obstacle race, side step, ball toss .....	.8060
Obstacle race, side step, basketball throw .....	.8022

thirty-minute class period would be sufficient to administer both tests to a class of forty-five.

Where equipment is available but time is limited, the following combination may be used, all requiring a catapult and assistance in running it if time is to be saved: ball toss and catch and throw (.860), sand bag distance and catch and throw (.850), ball toss and catching (.840), catch and throw and basketball throw (.827).

TABLE IV
CORRELATION OF TEST BATTERIES WITH CRITERION IV

Battery	R
<i>Two-item Combinations</i>	
Basketball throw, Sargent jump	.8753
Basketball throw, broad jump	.8617
Basketball throw, dash	.8599
G.M.A.Q., Brace	.8411
G.M.A.Q., basket shooting	.8312
Basketball throw, ball toss	.8229
Basketball throw, obstacle race	.8140
Sand bag distance throw, Sargent jump	.7860
Sand bag distance throw, broad jump	.7700
Ball toss, dash	.7493
Sargent jump, obstacle race	.7266
Obstacle race, broad jump	.7140
<i>Three-item Combinations</i>	
Dash, basketball throw, Sargent jump	.9060
Dash, basketball throw, broad jump	.8990
Obstacle race, basketball throw, Sargent jump	.8976
Dash, basketball throw, passes	.8973
Dash, basketball throw, ball toss	.8782
Obstacle race, basketball throw, broad jump	.8653
Obstacle race, basketball throw, dash	.8622
Obstacle race, sand bag distance, Sargent jump	.8081
Obstacle race, ball toss, broad jump	.7690
Obstacle race, passes, broad jump	.7578
Obstacle race, Brace, Sargent jump	.7440
Brace, Burpee, Sargent jump	.7099
<i>Four-item Combination</i>	
Dash, basketball throw, broad jump, passes	.9100

The above combinations would require approximately the same amount of time to administer, with the possible exception of the last, which may be arranged to economize time if the gymnasium is large enough to have several throwing at once. Both the sand bag and basketball throws require long rooms or outdoor space, while the ball toss may be given in a very limited space. It may be given to several at once if space permits.

Situation 3.—Desire for most effective evaluation and prediction of success in the general college program of physical education, equipment and time unlimited. The following combinations are suggested: dash, basketball throw, broad jump, passes (.910), dash, basketball

throw, Sargent jump (.906), dash, basketball throw, broad jump (.899), obstacle race, basketball throw, Sargent (.898), dash, basketball throw, passes (.897).

All have approximately the same degree of correlation with the composite criterion, but make slightly different demands on time and equipment. The difference between the four- and three-item combinations is not enough to warrant the use of the former.

This is probably the situation corresponding most nearly to the majority of college situations. This does not imply the desire for spending an extreme amount of time on a testing program. None of these combinations suggested would appear to be prohibitive or require an excessive amount of time.

Situation 4.—Same as 3, but with limitations on time or equipment. If both time and equipment are limited, the best combination appears to be basketball throw and dash (.860), or basketball throw and ball toss (.823). The latter is the same combination as one suggested for the evaluation of sports ability, and has approximately the same correlation with both criteria.

Other combinations requiring very little time and only a moderate amount of equipment are: basketball throw, Sargent jump (.875), basketball throw, broad jump (.862), basketball throw, obstacle race (.814).

Another possibility which takes a little more time but very little special equipment is dash, basketball throw, and obstacle race (.862).

Situation 5.—Desire for maximum supplementary information with unlimited time and equipment. Either of the following batteries might be used: G.M.A.Q. and Brace (.841), or G.M.A.Q. and basket shooting (.831). They are time-consuming in comparison to previously suggested combinations.

There is one definite use which might be made of measures secured in a longer battery. There are now available various scales and sets of norms on many of these activities. The student's score and improvement, presented in terms of these standards, might be used for motivation, or the tests repeated later in the course as a direct measure of accomplishment. If used for this purpose, more of the tests might be desirable. A table of T-scores for sixteen of the events is given in the Appendix. These are based on data from several hundred freshmen during the years 1935 to 1938. These could very well be used as achievement scales.

The obstacle race as used in this study has yielded only moderately good results. However, after considerable additional experience with it and administration to more than one thousand college women, mostly freshmen, the writer suggests further experimentation with it.

Situation 6.—Same as 5, but with limited time or equipment. The

best selection of items would be basketball throw, ball toss, sand bag distance, dash, obstacle race, repeated passes, and broad jump. These are selected on the basis of validity, reliability, economy of administration, and available standards of performance. Any number of items might be chosen from this list, or they may be used as suggested above in situations 2 and 4. The other events may be scored from the T-score tables and used for present status in those particular events or as a basis for practice and accomplishment records as suggested in situation 5. These items require a minimum of equipment, may be given indoors or outdoors, and can be given to several persons at one time if there is a reasonable amount of space. It will also be noted that

TABLE V
SIMPLIFIED FORMULAS RECOMMENDED FOR USE IN PREDICTING
ABILITY IN SPORTS

(1)	1. ball toss + 1. catch and throw (seconds)
(2)	1. sand bag distance + 2. catch and throw (seconds)
(3)	1. catching + 3.7 ball toss
(4)	2. basketball throw (feet) + 3. catch and throw (seconds)
(5)	2.3 ball toss + 1. sand bag distance
(6)	1. sand bag distance + 5.3 catching
(7)	1. basketball throw (feet) + 1.7 ball toss
(1)	1. ball toss + 1.1 sand bag distance + 1.5 catch and throw (seconds)
(2)	1.1 basketball throw (feet) + 1. sand bag distance — .3 ball toss
(3)	1.6 sand bag accuracy + 1. sand bag distance + 2.6 ball toss
(4)	3. basket shooting + 1. sand bag distance + 2. ball toss
(5)	1.1 side step + .6 catch and throw (seconds) — 1. obstacle race (seconds)

TABLE VI
SIMPLIFIED FORMULAS RECOMMENDED FOR USE IN EVALUATING
GENERAL ABILITY

(1)	1.2 Sargent jump (cm.) + 1. basketball throw (feet)
(2)	1.5 dash (yards) + 1. basketball throw (feet)
(3)	1.3 broad jump (inches) + 1. basketball throw (feet)
(4)	1. G.M.A.Q. + 2.5 Brace
(5)	1. G.M.A.Q. + 3.7 basket shooting
(6)	1. ball toss + 1.6 basketball throw (feet)
(7)	1. basketball throw (feet) — 1.1 obstacle race (seconds)
(1)	1. basketball throw (feet) + 1.2 dash (yards) + 1.1 Sargent jump (cm.)
(2)	1.5 basketball throw (feet) + 2. dash (yards) + 1. broad jump (inches)
(3)	1. basketball throw (feet) — .7 obstacle race (seconds) + 2. Sargent jump (cm.)
(4)	1. basketball throw (feet) + 2. dash (yards) + 3.4 passes
(5)	2. basketball throw (feet) — 1. obstacle race (seconds) + 1.4 broad jump (inches)
(6)	1.8 basketball throw (feet) + 5.2 dash (yards) + 1. ball toss
(7)	1. basketball throw (feet) + 2.6 dash (yards) — .5 obstacle race (seconds)
(1)	.7 basketball throw (feet) + 2. dash (yards) + 1. passes + .5 broad jump (inches)

these events are the most useful for prediction in various limited combinations.

The prediction formulas for all the batteries suggested above appear in Tables V and VI. They have been put into a simplified form for practical use.

CONCLUSIONS

The aim of the experiment was to evaluate the motor abilities of college women as a basis for guidance of the student in physical education, and for organization and content of classes. The following conclusions seem justified from these data.

1. Motor ability can be measured with a relatively high degree of validity, at least in terms of the criteria used in this study.

2. The composite criterion appears to be the best of the four used.

3. There is a variety of individual tests and combinations of tests which will effectively measure motor ability as here described.

4. Strength tests have little value in estimating the ability of college women.

5. The obstacle type of race probably has decided value, but the one used in this study needs further investigation.

6. The best single items as measured by the composite criterion are basketball throw, broad jump, Sargent jump, sand bag distance throw, ball toss, dash, and obstacle race.

7. The battery which appears best suited for use in the majority of college situations for the evaluation of general ability consists of dash, basketball throw, and Sargent jump; or obstacle race, basketball throw, and Sargent jump.

8. The batteries suggested constitute a useful basis for individual guidance and help in college physical education classes.

9. The reliability of performance of this group on most events was relatively low in comparison to findings on boys. This probably means that they should be given more trials on each item.

10. Further study would appear to be desirable. The problems which seem most significant are:

- a) Establishment of more practical criteria, perhaps with more consideration for the objectives of a college program,

- b) Use of tests which can be administered in such a way as to reduce to a minimum the fluctuations in performance which greatly lower reliabilities,

- c) Use of the obstacle type of test with an abbreviation of it, if possible.

BIBLIOGRAPHY

1. Alden, Florence D., Margery O. Horton, and Grace M. Caldwell, "A Motor Ability Test for University Women for the Classification of Entering Students into Homogeneous Units," *RESEARCH QUARTERLY*, 3:1 (March 1932) 85-120.

2. Collins, V. D., and Eugene C. Howe, "The Measurement of Organic and Neuro-muscular Fitness," *American Physical Education Review*, 29 (February 1924) 64.
3. Cozens, F. W., and Hazel J. Cubberley, "Achievement Scales in Physical Education for College Women," *RESEARCH QUARTERLY*, 6:1 (March 1935) 14-23.
4. Cozens, F. W., *The Measurement of General Athletic Ability in College Men*, (Eugene, Ore.: University of Oregon Publications, Physical Education Series 1, No. 3, 1929).
5. Driftmier, Erma, "Strength Tests for College Women Entrants," *RESEARCH QUARTERLY*, 8:1 (March 1937) 80-85.
6. Garfiel, Evelyn, "Measurement of Motor Ability," *Archives of Psychology*, 9 (1923) 47.
7. Halsey, Elizabeth, "Relation between Certain Measures of Mental and Physical Ability in College Women," Master's Thesis, Wellesley College, 1922.
8. Humiston, Dorothy, "A Measurement of Motor Ability in College Women," *RESEARCH QUARTERLY*, 8:2 (May 1937) 181.
9. Hyde, Edith I., "National Research Study in Archery," *RESEARCH QUARTERLY*, 7:4 (December 1936) 64-73.
10. Johnson, Granville, "Physical Skill Tests for Sectioning Classes into Homogeneous Units," *RESEARCH QUARTERLY*, 3:1 (March 1932) 128-136.
11. Johnson, W. L., "Objective Tests in Basketball for Boys," Master's Thesis, University of Iowa, 1934.
12. Kistler, Joy W., "The Homogeneous Grouping of Junior and Senior High School Boys for Physical Education Class Activities," *RESEARCH QUARTERLY*, 8:4 (December 1937) 11.
13. McCloy, C. H., "The Measurement of General Motor Capacity and General Motor Ability," *SUPPLEMENT TO RESEARCH QUARTERLY*, 5:1 (March 1934) 46-61.
14. McCloy, C. H., "A New Method of Scoring Chinning and Dipping," *RESEARCH QUARTERLY*, 2:4 (December 1931) 132-143.
15. McCloy, C. H., "Recent Studies in the Sargent Jump," *RESEARCH QUARTERLY*, 3:2 (May 1932) 235-242.
16. McCloy, C. H., "An Analytical Study of the Stunt Type Test as a Measure of Motor Educability," *RESEARCH QUARTERLY*, 8:3 (October 1937) 46-55.
17. Mitchell, A. Viola, "A Scoring Table for College Women in the Fifty-Yard Dash, Running Broad Jump, and Basketball Throw for Distance," *SUPPLEMENT TO RESEARCH QUARTERLY*, 5:1 (March 1934) 86-91.
18. Rogers, Frederick R., *Tests and Measurement Program in the Redirection of Physical Education*, (New York: Bureau of Publications, Teachers College, Columbia University, 1927).
19. Wayman, Agnes R., "A Scheme for Testing and Scoring the Physical Efficiency of College Girls," *American Physical Education Review*, 28 (November 1923) 415.

APPENDIX

DESCRIPTION OF TESTS USED IN ESTABLISHING SPORTS CRITERION

1. *Basket Shooting*.—This was given according to Johnson's technique.¹¹ The score is the number of baskets which the subject made in 30 seconds, shooting as rapidly as possible from any point on the floor. Scoring was done by partners, with a single timer for all baskets.

2. *Ball Toss*.—A rope was stretched as tight as possible between two regulation height baskets. The test is similar to the basket-shooting test. The subject stood anywhere she chose, the object being to throw the ball over the rope and

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catch it before it touched the floor. The score was the number of times the ball went over the rope and was caught in 30 seconds. Failure either to get the ball over or to catch it constituted failure on that particular throw. Instructions and demonstration were given and practice allowed. Scoring was done by partners, with a single timer. The test was taken on two different days and the final score was the sum of the two trials.

3. *Passes*.—A line was drawn on the floor 9' in front of a flat wall space. The subject stood behind this line, threw the ball against the wall, caught it and repeated as rapidly as possible for 15 seconds. Instructions and demonstrations were given and a few practice throws allowed. The score was the number of times the ball hit the wall.

4. *Sand Bag Distance Throw*.—This test was taken from the University of Wisconsin battery (unpublished). Two lines were drawn intersecting at right angles at point A. Using the point thus formed as a center, arcs were drawn on the floor, the first at 20 feet out, the second at 25 feet, etc., for 12 zones. The bags were 4" square, made of canvas, and weighed 1 pound each. A heavy rubber band was placed around the middle of the bag drawing it in in hourglass fashion to prevent sailing it. An overhand throw was used from behind the intersection of lines at point A. If the subject stepped or slid slightly over the lines, the trial was counted. If she stepped out 6" or more beyond the lines, the bag was not scored and another trial was taken. The recorder stood out in the throwing area and recorded the zone where the bag fell. The score was the sum for five trials. Instructions and demonstrations were given and practice allowed.

5. *Sand Bag Accuracy*.—The same bags were used as in the distance throw. The target on the wall was made up of five concentric circles of the same size as the regulation 48-inch archery target. The circles scored, from inside out, 5, 4, 3, 2, 1. The center of the target was 4' from the floor. The subject threw the bags with an overhand throw while standing behind a line 18' in front of the target. An assistant stood near the target and counted the zone in which the bag hit. The score was the sum made on 5 throws. Instructions and demonstrations were given and practice allowed.

6. *Batting*.—Home plate was located at a distance of 36' in front of the catapult. The catapult was adjusted so that the ball would pass over home plate at a height of approximately 3'. The balls used were 10-inch indoor, outseam balls. The subject had a choice of several light-weight bats. She stood in the batter's box and was instructed to spread her hands apart on the bat and to bunt rather than swing at the ball. This was done because of the lack of speed on the ball, the arc through which the ball traveled, and the limited space in which the test had to be given. Each subject was given 10 trials, and one point was scored for each ball which was struck into fair territory. Instructions and demonstrations were given, but no practice.

7. *Kicking*.—The test was administered to all by the writer, who rolled each ball with as nearly the same amount of speed as possible. The subject stood in or behind the kicker's box and was instructed to kick the ball alternately into right or left sides of the target area, the direction for each being called just before the ball was rolled. A regulation soccer ball was used and 10 trials given. The first 4 were rolled from line A, 18' in front of the box; balls 5, 6, and 7 from line B, and balls 8, 9, and 10 from line C. One point was scored for each ball kicked into proper area and not rolling out of it in less than 10 feet. Instructions and demonstrations were given, but no practice. (See Fig. I.)

8. *Catching*.—The base was located 36' in front of the catapult, and the machine was adjusted so that the ball would fall to the floor approximately 4' beyond the base. A line (A) was drawn 3' in front of the catapult. The girl was

instructed to stand on, or near the base, catch the ball and throw it back as quickly as possible against the wall beside the catapult. If a ball was dropped or missed it was recovered and thrown back in the same way. She knew that she was being scored both on the number of balls caught and time she consumed in getting balls back. The score was the number of balls caught out of ten. Instructions and demonstrations were given but no practice.

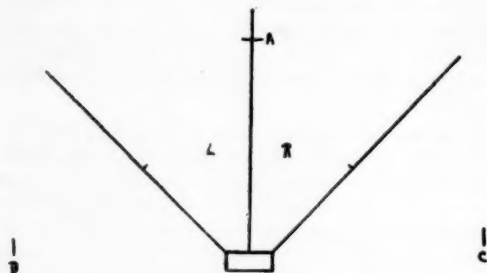


FIGURE 1

9. *Catch and Throw*.—The scores for catching, and catch and throw were taken at the same time. As the ball was released from the catapult, an assistant who stood at the end of line A started the stop watch. The watch was allowed to run until the ball crossed the line again as it was thrown back. The watch was started again with the next ball, and continued as before. After 5 balls, a record was made of the number caught and the time consumed. Another 5 balls were taken in the same way. The score was the total time for the 10 balls.

A DESCRIPTION OF TESTS AND INDICES USED IN OBTAINING THE EXPERIMENTAL DATA

Grip Strength, Back Strength, Leg Strength.—Rogers¹⁸ technique used in testing and scoring.

Chinning Strength, Dipping Strength, Strength Index, Physical Fitness Index.—McCloy¹⁴ technique used in testing and scoring.

Push, Pull.—Hand dynamometer with push-pull attachment was used. Subject held it in front of chest, elbows out at shoulder level.

Brace Test.—Technique of Iowa revision¹⁶ was followed.

Sargent Jump.—Instructions and practice were given previous to day of testing, and repeated on testing day. The leapmeter was used, measuring the distance jumped above standing height. Measurements were in centimeters. Two trials were recorded, the best record being used.

Burpee Test.—¹⁸ Instructions and practice were given previous to day of testing and repeated on the testing day. The score was the number of times, plus the fraction thereof, that the subject could repeat the following sequence of movements in ten seconds: from erect standing position down to squat rest, extend legs to front leaning rest, return to squat rest, and up to standing position.

General Motor Capacity Score.—Computed by the McCloy formula.¹³

Dash.—Running was done down a straight course marked in zones of one yard, each plainly numbered. Subject assumed any starting position she desired; starter, with stop watch, stood near starting line. She gave the signal, "Ready," blew the whistle, and at the end of four seconds blew the whistle again. An assist-

ant down the course recorded the zone in which the runner was when the second whistle blew.

Standing Broad Jump.—Jumping was done indoors, on a marked gymnasium mat, and a beat board used for take-off. Instructions were given and practice allowed. Three trials were given and the best used.

Basketball Throw for Distance.—Subject threw from behind a line, being allowed a running approach if she wished. Instructions were given and practice allowed. Three trials were given and the best used.

Total Points, General Motor Ability Quotient.—Computed from McCloy¹³ scale.

Johnson Test.—Johnson's¹⁰ method of scoring and administering was followed on mats with regulation canvas target.

Dodge Run.—⁴ A demonstration was given, and the subjects were allowed to walk through the course so as to be familiar with the path. One trial was allowed, time recorded in seconds.

Side Step.—Two lines, 5' 10" apart, were used. Subject stood between lines with a foot touching one line. On signal, "Ready," whistle, she did a cut step sideward so as to place the other foot on the opposite line, and repeated back and forth. Score was number of trips across the space in fifteen seconds. Instructions and practice were given.

Shuttle Race.—Two lines, 15' apart, were used. Subject stood with toes at edge of line. On signal, "Ready," whistle, she ran to touch the opposite line with one foot, returned to touch first line, and repeated the round trip. Instructions and demonstration were given but no practice. Time was recorded in seconds.

Bass Balance Test.—The test consists of leaping on one foot into an eight-inch circle, without touching line or hopping about, and holding the balance, if possible, up to but not exceeding five seconds. A series of ten circles is taken in the same way on alternate feet. Score is total time used minus three times the errors. Maximum possible score is fifty. Minus scores were tabulated as zero.

CONSTRUCTING THE OBSTACLE RACE

The preliminary study was made using thirty-three sophomore women as subjects. Fourteen items were constructed subject to the following criteria: (1) necessitate handling the body in a variety of ways; (2) suitable for combining with other items; (3) require a minimum of equipment, or that which would be found in the average gymnasium; (4) safe enough to be administered to a group of college students without training.

The events selected for use were:

1. Start lying on back, heels on starting line in direction run is to be made, get up and run 30 feet.
2. Long sitting position, back to direction of run, heels on starting line, get up and run 30 feet.
3. Run 20 feet, crawl on hands and knees the length of an 8-foot mat, get up and run 15 feet.
4. Run 15 feet, lie down on mat, roll over and over the length of an 8-foot mat, get up and run 15 feet.
5. Run 15 feet, jump across a mat 3' 9" wide, run another 10 feet, jump a second mat, and run 10 feet to finish.
6. Run 10 feet, pick up a basketball lying in the course, run 20 feet and place in on a one-foot circle.
7. Run 20 feet, circle twice around a jump standard in either direction without holding to it, return to the starting line.

8. Run 20 feet and do a figure eight through four Indian clubs set on the corners of a 5-foot square, run 15 feet to finish.

9. Shuttle run, two round trips back and forth between two lines 15 feet apart.

10. Run 5 feet, step up with both feet on a stall bar bench, dismount and continue 10 feet to second bench and repeat mount, continue 10 feet to third stool and repeat, run 10 feet to finish.

11. Run 15 feet, crawl or roll under boom set 18 inches from floor, without holding to boom, get up and run 15 feet to finish.

12. Run 10 feet, hurdle or jump in any style desired over a two-foot hurdle, continue 15 feet to second hurdle, run 10 feet to finish.

13. Run 15 feet, climb or vault in any style desired over box 41 inches high, and run 15 feet to finish.

14. Run 15 feet to parallel bars, set 45 inches high and covered with mats, climb over in any style and run 15 feet to finish.

Each event was described and demonstrated before subjects ran. Starter stood at starting line and gave the signal "Ready," whistle. The timer stood at the finish line. In all events except No. 9, a flag representing the finish was placed 10 feet beyond the actual finish line. The subjects were told this was the finish in order to secure as nearly as possible maximum speed throughout the length of the course, and if they slowed down before the end the lessened speed would be in the extra ten feet.

The subjects ran one at a time, and had sufficient time to rest while others were running. Three instructors in the department of physical education acted as judges, watching each girl on each event, and scored her for each event according to skill, ease, and economy she showed in performing the stunt. Scoring was on a basis of 1 to 5. After all events were run, each judge gave each subject a final rating by the same scale based on the cumulative score, her general impression of the individual's ability, and by comparison with the rest of the subjects. The judges' scores were then added together giving a possible rating score of 3 to 15.

The time for each event was correlated with rating score. Table VII gives these correlations. Events 1 and 2 were both forms of a start, and 1 was selected since it gave a slightly higher correlation. The next five highest correlations were selected for the remainder of the race. Figure II gives the details of the events as they were put together.

Subjects running the race were given the following instructions. Lie on your back with your heels at this line (line a). On the signal, "Ready," whistle, get up and start running as quickly as possible. Run to first stool, step up with either foot then up with second foot, step down on other side with first foot and continue running. Second and third stools are taken in the same way. Approach jumping standard from either side, circle it twice without holding on. Run back down the line of the hurdles, jumping them in any style you choose. Run around behind the two Indian clubs and come back to the boom. Crawl, roll or slide under any way you choose but without holding on. Get up and run to touch the finish line (line c) but turn back again and make two round trips back and forth between these two lines (c and b) before stopping.

A demonstration of the race was then given and any questions answered. For failure to put both feet on the stool or to follow proper route at any time, the subject was stopped and ran again later. Swinging hurdles were used, and she was not penalized for catching her toe since it was found the time so lost made up for the error.

Jumping standards with a bar across could be used instead of the boom. One person can act as both starter and timer. If two timers are available both can work at the same time, starting subjects alternately, thus keeping two going and saving time in administering.

The race was then run by the thirty-three subjects on two different days. Scores on the two days gave a reliability coefficient of .90. The correlation with ratings previously given them by the judges was .645. This was considered sufficiently high to include the trial battery.

Later during the administration of tests to the freshmen, another group was given the race on successive days. The reliability coefficient on this group of sixty-nine subjects was .91.

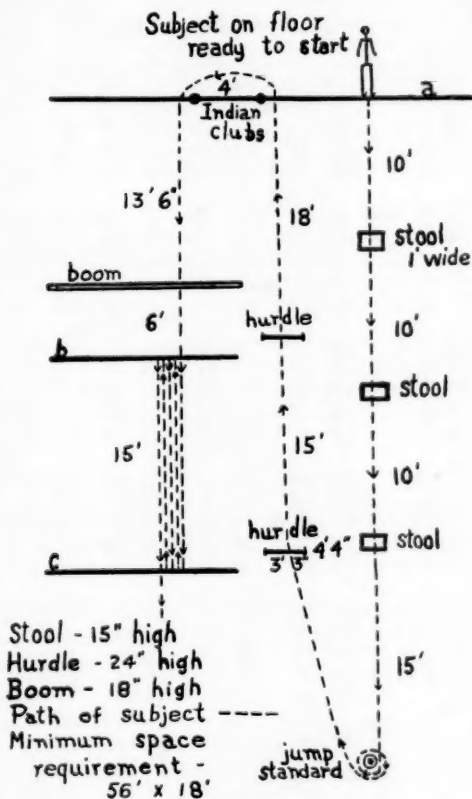


FIGURE II

TABLE VII
CORRELATION BETWEEN TIME AND RATING ON EVENTS
FOR OBSTACLE RACE

Event	<i>r</i>	Event	<i>r</i>	Event	<i>r</i>
1*	.754	6	.547	11*	.668
2	.712	7*	.724	12*	.780
3	.657	8	.545	13	.659
4	.625	9*	.829	14	.641
5	.513	10*	.754		

* Events chosen for obstacle race.

TABLE VIII
T-SCORES

Brace (411)*	Sargent (422)*	Burpee (428)*	G.M.C. (433)*	G.M.A.Q. (383)*	Obstacle (953)*	Basketball Throw (742)*	Dash (755)*
20 76	53 80	7½ 80	530 76	170 80	22 81	75 82	35 51
19 72	50 78	¾ 78	520 74	165 78	23 78	64 78	34 50
18 70	49 77	7 76	510 71	160 78	24 77	63 77	33 48
17 68	48 73	¾ 75	500 69	155 77	25 75	62 76	32 47
16 66	47 71	½ 72	490 66	150 76	26 73	61 75	31 46
15 64	46 69	¾ 70	480 63	145 74	27 68	60 74	30 45
14 60	45 68	6 67	470 61	140 72	28 64	59 73	29 43
13 57	44 66	¾ 64	460 59	135 71	29 60	58 72	28 42
12 55	43 65	½ 62	450 57	130 67	30 57	57 71	27 41
11 53	42 64	¾ 60	440 55	125 65	31 54	56 70	26 39
10 50	41 62	5 55	430 52	120 62	32 51	55 69	25 37
9 48	40 59	¾ 51	420 50	115 61	33 48	54 68	24 35
8 45	39 57	½ 47	410 48	110 57	34 45	53 67	23 34
7 43	38 55	¾ 44	400 45	105 55	35 43	52 66	22 32
6 41	37 53	4 40	390 43	100 53	36 41	51 66	21 31
5 38	36 52	¾ 35	380 41	95 49	37 39	50 65	20 29
4 35	35 50	½ 33	370 39	90 47	38 37	49 64	19 27
3 31	34 48	¾ 31	360 36	85 44	39 35	48 64	18 25
2 28	33 47	3 29	350 34	80 41	40 34	47 63	17 24
1 21	32 45	¾ 27	340 31	75 37	41 33	46 62	16 23
	31 43	½ 26	330 29	70 34	42 32	45 61	15 22
	30 41	¾ 25	320 27	65 30	43 31	44 60	14 22
	29 39	2 24	310 26	60 26	44 30	43 59	13 19
	28 38	¾ 21	300 25	55 21	45 29	42 58	
	27 37		260 24		46 28	41 58	
	26 35		240 19		47 27	40 57	
	25 34				48 26	39 56	
	24 32				49 25	38 55	
	23 30				50 24	37 54	
	19 26				52 24	36 52	
					57 23		
					58 21		
					59 17		

* Indicates the number of subjects on which the scale is based.

Changes in the Ages and Physical Measurements of Students at the University of Michigan, as Noted by a Comparison between Two Freshmen Groups (1899-1900 and 1938)

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EVIDENCE from a number of past investigations concerning the status of college men has shown that the phenomena of height and weight increase is occurring all over the country. That is to say, repeated measurements taken over periods of years show this to be the trend. This particular study was undertaken with the thought that to consider body measurements other than height and weight might increase available knowledge and contribute some further data to this general topic of widespread interest.

PURPOSE

The purpose of the study was to compare the mean anthropometric measurements of a group of University of Michigan male students of yesteryear to the corresponding mean measurements of a present-day group at the same institution. In addition to age, these measurements include: height, weight, muscular, expanded and contracted chest girths, the girths of both upper arms in the normal (arm down) and contracted (arm up) positions, the girths of the thighs, and the girths of the calves.

SOURCE OF DATA AND METHOD OF PROCEDURE

There are on file in Waterman Gymnasium at the University of Michigan yearly records containing the individual anthropometric measurements of various entering freshmen groups. Records of the total number of cases as examined and recorded during the years 1899 and 1900 were collected, as were the records for the students comprising the 1938 entering group. This approximate forty-year time interval was selected for two reasons: first, to insure a favorable comparison of groups separated by more than a single generation and second, because of the number of cases and the accuracy of the available data.

The study is limited in that the 1785 cases used were selected because of the availability, content, and accuracy of the records on file. The definite number of cases (607) comprising the early group com-

stitute the total number of male entrants examined upon entering the University during the school years 1899-1900 and 1900-1901. The number of cases (1178) making up the modern group represent only those male students that entered the University in September, 1938, as freshmen with no previous credit for college physical education. That is, detailed anthropometric records are not recorded at the present time of students entering with advanced standing or of those entering the graduate divisions of the University.

Each measurement was completed and recorded through the examiner's utilization of a definite measuring technique. These methods, similar to those outlined by Seaver^{1*} were employed during the years 1899 and 1900 just as they are today.

In treating the data used in the study the complete measurements of each case were transposed from the available records on to Hollerith cards, according to a previously arranged code as is required when using the Hollerith system for purposes of tabulation. Notations were made on each card to include: case number, age, height, weight, three chest girths, four arm girths, and two thigh and two calf girths. The various mean measures were computed for each group and are presented in table form in order to obtain a general picture of the freshman physique of '99-'00 in contrast to the freshman physique of '38.

TABLE I
PERCENTAGE FREQUENCIES OF THE AGES OF TWO GROUPS OF ENTERING
MALE STUDENTS AT THE UNIVERSITY OF MICHIGAN
(1899-1900 AND 1938)

Age	Percentage Frequencies	
	(1899-1900) (607 Cases)	1938 (1178 Cases)
17 and under	6.9%	29.6%
18	20.9	46.4
19	17.2	12.5
20	14.5	5.5
21	16.7	2.7
22 and over	23.8	3.3

THE RESULTS

The Age Distributions.—As demonstrated in Table I, it is obvious that the distribution of ages for the two groups of students are quite unlike. In the early group the largest number of cases were 22 years of age or over, whereas in the 1938 group the greatest percentage were in their 18th year. It is interesting to note the reversal of percentages in the two groups concerning the 17 years and under level and the 22 years and over level. The mean for the 1899-1900 group is 20.71 years, while the mean for the 1938 group is 18.65 years.

* Numbers refer to Bibliography at end of article.

Table II illustrates the mean measurements for each group of freshmen. This table presents a picture of the average male student of 1900 as compared to the average student of 1938.

The 1938 student entered the University 2.06 years earlier in life than did the freshman in 1899-1900. He was taller than his predecessor by 1.01 inches and was 7.27 pounds heavier. These latter increases are very significant ones in themselves, and even more so because of the accompanying decrease in age. The muscular chest girth shows a positive increase of .29 inches in the 1938 student. This is a very small difference, but is significant because of the increase in height.

TABLE II
CONTRAST OF THE MEAN MEASUREMENTS OF THE 1899-1900 AND THE 1938
UNIVERSITY OF MICHIGAN GROUPS

Measure	Means (1899-1900)	Means (1938)	Difference
Age	20.71 Yrs.	18.65 Yrs.	- 2.06 Yrs.
Height	67.88 Ins.	68.89 Ins.	+ 1.01 Ins.
Weight	137.07 Lbs.	144.34 Lbs.	+ 7.27 Lbs.
Chest Muscular	34.83 Ins.	35.12 Ins.	+ .29 Ins.
Chest Expanded	35.21	34.98	- .23
Chest Contracted	32.48	32.00	- .48
Right Arm Down	10.60	10.81	+ .21
Right Arm Up	11.48	11.82	+ .34
Left Arm Down	10.35	10.63	+ .28
Left Arm Up	11.20	11.56	+ .36
Right Thigh	20.22	21.09	+ .87
Right Calf	13.58	14.02	+ .44
Left Thigh	20.07	20.99	+ .92
Left Calf	13.59	14.00	+ .41

In the chest expanded measurement we have a decrease of .23 inches between the means of the two groups, demonstrating that the average expanded chest of the 1938 freshman was slightly less than was that of the 1899-1900 student. The contracted chest girth of the later student is shown to be less in girth than the corresponding measure for the 1899-1900 student, a difference of .48 inches. By subtracting in each case the contracted mean measure from the expanded mean measure, we find that the actual amount of so-called chest expansion ability is 2.73 inches for the 1899-1900 student and 2.98 inches for the 1938 man, showing an increase of .25 inches.

As to upper arm measurements, we note in table II that the positive increases are small in each girth. Average muscular girth (arm up) shows an increase of .34 inches on the right arm and .36 inches on the left arm. The normal measure (arm down) shows an increase of .21 inches on the right and .28 inches on the left. In both cases the increase of the left arm exceeds the increase of the right arm. The girth of the expanded upper arm (biceps contracted) is greater on the present-day freshman and also, the power of expansion has increased. The 1899-

1900 student increased the dimension of his upper, by contracting the biceps only .88 inches, whereas the 1938 student increased the dimension 1.01 inches. This is also true of the left arm; in this case the power of expansion has increased from .85 to .93 inches.

Average thigh measurements of the two groups demonstrate the right thigh to have a larger girth than the left in the 1899-1900 group. In the later group (1938) we have a reversal of this, in that the left thigh shows greater average girth than does the right. The difference in both cases is approximately the same. There has been a positive increase of girth in both thigh measures of the 1938 group over the early group, amounting to .87 inches on the right thigh and .92 inches on the left.

The increase of calf girths is about the same for both left and right calves. The right calf of the modern freshman has increased .44 inches over that of the student of yesteryear and the left calf shows an increase of .41 inches. The left calf of the 1900 freshman was slightly larger than his right, a difference of .01 inches, whereas the right calf of the 1938 student is some .03 inches larger than his left.

CONCLUSIONS

The 1938 freshman at the University was decidedly younger, taller, and heavier than his predecessor of 1899 and 1900.

The mean age, height, and weight measures of the 1938 Michigan group display differences (in comparison to the early group) which are in accord with the findings of similar comparisons at other institutions as published in past investigations. MacKinnon and Jackson² compared groups of Minnesota students separated by a thirty-year time interval and the results showed evident changes between the groups. The changes between the student groups at the University of Michigan are even greater than those exhibited at Minnesota. At the University of Cincinnati, Chenoweth's³ study of student groups, involving a twenty-year time interval, showed only a slight increase in age but exceptional increases in height and weight. These latter changes are greater than those at Michigan, but it must be remembered that the Cincinnati groups contained relatively small numbers of cases.

The anthropometric girths of arm, leg, and chest all show positive increase in the 1938 group over the 1899-1900 group, with the exception of the chest expanded measurement. Here the difference appears as a decrease in average girth for the 1938 group. The thigh seems to have added the greatest increase to its circumference, almost a full inch on each leg. Concerning the calf measure, the 1938 freshman had a calf girth (on the leg) just about one-half inch larger than his fellow of 1900. These last mentioned results would tend to support the conclusions of Bowles⁴ (Harvard) concerning greater increases of girth on the upper sections of extremities than on the lower sections.

All of the increases in dimension of body parts are in keeping with the average weight gain of some seven pounds, but it must not be forgotten that there has also been an accompanying gain in height which would tend to compensate for the gain in weight and so detract from its (the weight gain) influence on body parts. However, in this case the various increases in girths have made themselves obvious in spite of the increased height of the average individual. If the weight increase were to compensate the height increase, then only increased muscular development would sustain the increases in size of body parts which have made themselves evident on the 1938 student.

As mentioned previously, increased gains in girth for all the anthropometric measurements referred to in the study were evident on the average freshman of 1938 with the exception of one measure, that of chest expanded. The mean for this measure represents merely a limiting girth after complete inhalation and in no way refers to power of chest expansion or an indication of lung capacity. In this case the mean girth for the modern group was less than the mean girth for the early group. However, in compensatory fashion, the mean contracted chest girth for the 1938 group was less in dimension than was this same girth for the 1899-1900 group. The actual range of expansion figure, as measured from contracted limit to expanded limit, is greater for the modern group. The difference in the mean limit measures between the two groups may be something which is unaffected by total body weight and height increase, and may merely be a question of elasticity of muscle tissue.

The normal dimensions for both upper arms demonstrate an increase in girth by the 1938 group and also, there is an increase in the muscular girths. The range from normal to the expanded limit is greater on the part of the average 1938 freshman. The gain in total body weight might account for the increased girth of the arm in normal position, but any substantial increase of the girth by contracting the biceps is presumably due to muscular development. Results of this study show that the average freshman of 1938 possessed greater power of expanding the upper arm upon flexing the biceps than did the average freshman of 1899-1900.

The Possible Causes.—Much research has been completed in the past concerning the increase in size of the average college student over his predecessor of previous years. Many of the investigators have offered, in their publications, personal opinions as to the possible (and probable) causes for this phenomenon. In the main, these discussions by various individuals are similar in content. It is believed that the increasing size of the college student has been, and is, affected by such factors as: better care in infancy and childhood; less communicable disease; higher standards of living; a higher degree of intelligence

among people in general; also, better environmental and hygienic conditions, including diet, clothing, exercise, and medical care; finally, increased activity and the marked development of physical education.

This study has indicated that in addition to an increase in height and weight, the average male student of today exhibits a presumably greater muscular development of body parts in comparison to his predecessor of yesteryear. Increased physical activity and the great advance of physical education are probably the most pertinent answers to this occurrence.

BIBLIOGRAPHY

1. Seaver, Jay W., *Anthropometry and Physical Examination*. (New Haven: The Curtiss-Way Company, 1909) Chapter III.
2. MacKinnon, D. C., and Jackson, C. M., "Changes in the Physical Measurements of the Male Students at the University of Minnesota During the Last Thirty Years," *American Journal of Anatomy*, XLVII (March 1931) 405-423.
3. Chenoweth, Laurence B., "Increase in Height and Weight and Decrease in Age of College Freshmen over a Period of Twenty Years," *Journal of the American Medical Association*, CVIII (January 30, 1937) 354-356.
4. Hooten, E. A., "A Glimpse of Human Evolution at Harvard," *Harvard Alumni Bulletin*, XXXIII (May 1931) 994-998.

A Survey of Recreational Interests and Pursuits of College Women

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THE relative importance of training for wise use of leisure time as an objective in physical education is a matter of some question. Although individuals differ in the emphasis which they give to recreational activities, all will agree that they have become an established unit in any physical education program. The value of the present physical education curriculum as far as its contribution to recreation is concerned can best be measured by its effect on the students involved. Knowledge, therefore, of those activities in which students participate during their leisure time will give a good indication of the associations they have made between physical education activities and leisure-time pursuits. By means of a survey of the entire field of recreation, that is to say literature, drama, music, home recreation, as well as sports, conclusions might be drawn regarding the importance given by students to physical activities in their recreational pattern.

STATEMENT OF THE PROBLEM

It has been the purpose of this study to discover the recreational interests and pursuits of college women in the Central District of the American Association for Health, Physical Education, and Recreation. We hoped to find out what college women do with their leisure time. We also hoped to discover what students want to do, how a list of their recreational desires would compare with a list of the activities in which they have had instruction, and lastly, in what activities they feel the need for instruction.

RELATED INVESTIGATIONS

The Leisure Hours of Five Thousand People,^{1*} a survey conducted by the National Recreation Association, attempted to find out what people do in their free time. Their study included both men and women, employed and unemployed, and all possible educational variables. Saxman carried out a study in 1926 to evaluate physical education activities for leisure-time use.² Craig made a study of recreational preferences of college men at the University of Illinois.³ Cameron also

A summary of a paper presented at the annual convention of the Central Association of Physical Education for College Women, Minneapolis, Minnesota, March 29, 1938.

* Refer to numbered Bibliography at end of article.

carried out a study of the recreational activities of three hundred thirty-five business and professional men in Iowa.⁴ Stuhr made a study of interests and abilities as a basis for program planning.⁵ Waggoner also carried out a study of interests as related to the physical education program.⁶ Lee reports a study made at the University of Nebraska of recreational preferences of entering freshmen women in the fall of 1934.⁷ At Wellesley College, an interesting survey was carried out by Weidemann and Howe covering recreational interest of all four classes.⁸

PROCEDURE

A list of all colleges included in the central district was first compiled, and preliminary questionnaires were sent to the department of physical education for women in each of the institutions included in this list. This questionnaire attempted to analyze recreational administration and facilities in each specific school. It included such data as the size of the town in which the college is located, enrollment in the college, per cent of students working, range of student budget, size of physical education staff, and a subjective rating of recreational facilities. The results of these questionnaires were tabulated and twelve institutions chosen for further study. These twelve represented four different types of institutions and were considered to be as nearly as possible typical of the entire group to which they belong.

TABLE I
INSTITUTIONS INCLUDED IN THIS STUDY

<i>Universities:</i>	<i>State Colleges:</i>
1. Kansas University, Lawrence.	1. Kansas State College, Manhattan.
2. Colorado University, Boulder.	2. Iowa State College, Ames.
3. Missouri University, Columbia.	<i>Teachers Colleges:</i>
<i>Liberal Arts Colleges:</i>	1. Northeast Missouri Teachers College, Kirksville.
1. St. Olaf College, Northfield, Minn.	2. Northern State Teachers College, Aberdeen, South Dakota.
2. Grinnell College, Grinnell, Iowa.	3. Colorado Teachers College, Greeley.
3. Cornell College, Mt. Vernon, Iowa.	4. Moorhead Teachers College, Moorhead, Minnesota.

A second questionnaire form was assembled for distribution among students in physical education classes of the twelve selected institutions. On the first page of this form the student was instructed to check only those activities engaged in during the past year. The student was also asked to check her classification, major and minor departments, living arrangements, total number of hours per week spent attending classes or meetings, or working for pay, tuition, room and board. It was believed that these facts might be used to advantage in interpreting recreational participation and interest as the amount of time available is, no doubt, one of the most important items in determining the character and extent of student recreation.

In choosing the list of activities included in the form, an attempt was made to select a representative sample, since it would be impossible to cover the entire field of recreation. Physical education activities were placed first because the study was sponsored by that department. These activities included sections on individual sports, team sports, outing activities, aquatics, and dancing. Other sections were included on leadership, dramatics and stagecraft, hand-craft, art, music, home recreation, literature, motoring, and a miscellaneous section including such items as contests, puzzles, eating between meals, etc. Part II on the last page of the questionnaire included a check list of specific types of radio programs, a section on "dating," and another on clubs and organizations.

A total of 3,400 questionnaires were sent out. These forms were addressed to a member of the staff of the physical education department. They were distributed among the classes and in most cases were made out and returned during that class period.

During the entire treatment of these data the four types of colleges, i.e., universities, state colleges, liberal arts colleges, and teachers colleges, have been treated as separate units. The four classes have also been kept distinct. The living conditions as recorded on the first page were divided for this study into two groups, those living at home and those "abroad," a term which has been coined to mean the entire group of dormitory, sorority, and rooming house arrangements. This group was combined because of the resulting small numbers in more detailed separation. Hours working for pay, tuition, board and room appeared to be one item of greatest variation and the one which would be apt to have the greatest influence on recreation. The range of working hours fell quite easily into three groups, those not working, those working less than twenty hours per week, and those working twenty-one hours or more per week.

Following these divisions the questionnaires were sorted into types and the answers tabulated. Percentages were calculated on every item for each group in order to make comparisons.

INTERPRETATION OF THE DATA

In considering the recreational interests of the entire group of college women, determined by combining the four types, we find surprising similarity between the activities ranking high for college women and the similar list compiled by the National Recreation Association in its study of five thousand people.

Apparently the recreational activities of college women are very similar to the activities of the average citizen. Whether or not the character or quality of the recreation is any different is a point which cannot be ascertained from present available data.

Comparing recreational participation in each of the four types of

institutions studied we find again considerable similarity. The same similarity can be noted in an identical study made by Johnson for two atypical schools, namely, the University of Minnesota and Stephens College.⁹

The possible responses for the section of the questionnaire form dealing with participation were either *occasional* or *often* participation, so a further sorting was made to compare this variable. On the whole the *often* participation lists included more inactive forms of recreation than did the list of activities highest in *occasional* participation.

A comparison of the tables for various classes, freshmen, sophomores, juniors, and seniors, within each type of institution, shows no noticeable differences in the general recreation pattern, the same list of activities being as high for seniors as for freshmen. It would seem,

TABLE II
HIGHEST ACTIVITIES ON BASIS OF TOTAL PARTICIPATION

College women		N.R.A. study
1. Dating at movies	(92 per cent)	1. Newspaper
2. Picnicking	(84 per cent)	2. Radio
3. Radio	(83 per cent)	3. Fiction
4. Newspaper	(81 per cent)	4. Conversation
5. Funny papers	(79 per cent)	5. Non fiction
6. Hiking	(78 per cent)	6. Auto riding
7. Eating between meals	(72 per cent)	7. Visiting
8. Novels	(70 per cent)	8. Movies
9. Social dancing	(69 per cent)	9. Swimming
		10. Letter writing

also, that living conditions as we have analyzed them into the two groups, "home" and "abroad," have very little effect on recreation.

Working conditions were recorded as zero work, work 20 hours and less per week, and work 21 hours and more per week. A slight drop in participation percentages can be noted in comparing the zero work group and the 21 hours and plus group on the column of "often" participation. Such a relationship does not hold true, however, for the "occasional" participation column. In fact, in a great many cases, the 21 hours and plus group is higher in "occasional" participation than the zero work group. The relationship between hours of work and recreation is probably a more individual matter, some students both working and taking part in many activities while others, though they do not work, take part in only a few recreational activities. Treating the data in large groups as has been done in this study makes any conclusion regarding individual range of interest inaccurate.

In separate columns of the questionnaire the student was asked to check those activities in which she had had instruction, the activities in which she would like to participate and those in which she felt the need for instruction.

TABLE III
HIGHEST ACTIVITIES ON BASIS OF TOTAL PARTICIPATION

Universities	Teachers Colleges	State Colleges	Liberal Arts Colleges	Minnesota*	Stephens College*
1. Newspaper (89 per cent)	Funny paper (90 per cent)	Newspaper (92 per cent)	Picnicking (95 per cent)	Cosmopolitan† (95 per cent)	Picnicking (92 per cent)
2. Picnicking (83 per cent)	Hiking (90 per cent)	Dating (88 per cent)	Hiking (93 per cent)	Newspaper (91 per cent)	Eating (91 per cent)
3. Funny paper (82 per cent)	Newspaper (89 per cent)	Radio (88 per cent)	Newspaper (90 per cent)	Hiking (90 per cent)	Novels (88 per cent)
4. Eating (79 per cent)	Cosmopolitan† (87 per cent)	Hiking (85 per cent)	Eating (88 per cent)	Novels (87 per cent)	Newspaper (87 per cent)
5. Dating (77 per cent)	Cooking (84 per cent)	Picnicking (84 per cent)	Funny paper (86 per cent)	Social dance (83 per cent)	Swimming (87 per cent)
6. Social dancing (75 per cent)	Dating (81 per cent)	Cosmopolitan† (83 per cent)	Readers Digest† (86 per cent)	Bicycling (79 per cent)	Cosmopolitan† (86 per cent)
7. Readers Digest† (75 per cent)	Novels (81 per cent)	Funny paper (82 per cent)	Trips (84 per cent)	Readers Digest† (76 per cent)	Social dancing (85 per cent)
8. Novels (73 per cent)	Radio (80 per cent)	Entertaining (81 per cent)	Dating (83 per cent)	Trips (75 per cent)	Funny papers (85 per cent)
9. Entertaining (68 per cent)	Entertaining (79 per cent)	Novels (79 per cent)	Entertaining (83 per cent)	Entertaining (75 per cent)	Trips (84 per cent)
10. Radio (65 per cent)	Card games (76 per cent)	Cooking (75 per cent)	Radio (80 per cent)	Eating (75 per cent)	Motoring with stops (84 per cent)
Number of students 720	509	677	480	184	204

* Johnson, *op. cit.*, p. 9. The same note applies to later tables.

† Or magazines of that type. The same note applies to later tables.

TABLE IV
HIGHEST OFTEN PARTICIPATION

Universities	Teachers Colleges	State Colleges	Liberal Arts Colleges	Minnesota*	Stephens College*
1. Newspaper (66 per cent)	Newspaper (65 per cent)	Newspaper (65 per cent)	Newspaper (66 per cent)	Newspaper (71 per cent)	Social dance (69 per cent)
2. Social dance (60 per cent)	Funny paper (61 per cent)	Radio (59 per cent)	Radio (62 per cent)	Cosmopolitan† (55 per cent)	Newspaper (62 per cent)
3. Funny paper (56 per cent)	Radio (56 per cent)	Social dance (58 per cent)	Picnicking (62 per cent)	Hiking (54 per cent)	Novels (59 per cent)
4. Radio (52 per cent)	Picnicking (53 per cent)	Funny paper (56 per cent)	Funny paper (58 per cent)	Social dance (51 per cent)	Funny paper (58 per cent)
5. Dating (48 per cent)	Cooking (51 per cent)	Picnicking (51 per cent)	Hiking (54 per cent)	Novels (42 per cent)	Cosmopolitan† (58 per cent)

TABLE V
HIGHEST OCCASIONAL PARTICIPATION

Universities	Teachers Colleges	State Colleges	Liberal Arts Colleges	Minnesota*	Stephens College*
1. Croquet (52 per cent)	Dating (55 per cent)	Croquet (55 per cent)	Croquet (60 per cent)	Cards (49 per cent)	Roller skate (54 per cent)
2. Roller skate (50 per cent)	Roller skate (53 per cent)	Dating (51 per cent)	Roller skate (59 per cent)	Roller skate (49 per cent)	Bicycling (52 per cent)
3. Bicycling (46 per cent)	Entertain (53 per cent)	Roller skate (50 per cent)	Coasting (55 per cent)	Trips (46 per cent)	Motoring (58 per cent)
4. Baseball (45 per cent)	Cards (48 per cent)	Trips (48 per cent)	Table tennis (52 per cent)	Entertain (46 per cent)	Cards (41 per cent)
5. Picnicking (43 per cent)	Croquet (47 per cent)	Cards (48 per cent)	Dating (50 per cent)	Novels (45 per cent)	Entertaining (40 per cent)

A list of the five highest activities from Table VI, the percentage of students who have had instruction in activities, would include: basketball, volleyball, swimming, baseball, and clog and tap. In com-

TABLE VI
PERCENTAGE OF STUDENTS WHO HAVE HAD INSTRUCTION IN ACTIVITIES

Activity	Universities	Teachers Colleges	L. A. Colleges	State Colleges
	Fr.Soph.Jr. Sr.	Fr.Soph.Jr. Sr.	Fr.Soph.Jr. Sr.	Fr.Soph.Jr. Sr.
Total Number of Students	325 220 91 84	270 214 25 26	221 135 74 50	400 192 52 31
Archery	27 32 45 32	16 29 37 34	50 44 48 70	16 25 33 45
Baseball	42 52 60 62	10 43 68 46	48 48 22 46	14 46 42 81
Basketball	50 56 57 56	53 46 76 69	65 67 65 48	57 56 42 78
Clog and Tap	35 40 43 52	29 40 56 58	34 36 42 50	29 27 29 42
Cooking	35 36 26 26	35 39 44 19	40 41 48 40	42 47 40 71
Diving	20 30 41 44	14 27 28 54	24 37 37 38	25 33 46 55
Dressmaking	31 28 37 30	41 36 44 27	41 41 46 28	44 46 39 55
Folk Dancing	18 26 46 36	22 39 56 58	13 33 39 38	19 27 31 52
Glee Club	32 29 37 31	33 34 32 46	46 37 37 40	29 41 31 32
Hockey	23 26 36 37	7 21 52 38	28 34 41 30	14 28 31 49
Instrument	37 37 45 44	32 40 52 31	49 50 43 44	44 41 33 36
Soccer	26 27 29 32	24 33 64 42	22 37 26 30	22 29 15 45
Swimming	40 58 63 56	34 54 52 69	44 65 76 66	52 60 52 84
Volleyball	45 57 62 52	44 43 60 34	53 65 22 44	48 49 56 71

	Minnesota*				Stephens*	
	Fresh.	Soph.	Jr.	Sr.	Fresh.	Soph.
Total Number of Students	63	68	22	31	106	98
Archery	29	50	55	38	34	38
Badminton	16	25	46	38	20	20
Baseball	44	50	50	68	46	40
Basketball	48	68	73	65	50	41
Bridge	13	24	36	26	31	36
Choir	25	19	36	39	34	23
Cooking	32	46	59	52	32	29
Clog or Tap	43	35	55	61	51	55
Deck Tennis	27	41	23	42	19	14
Diving	24	32	50	35	33	31
Dressmaking	38	35	55	48	36	39
Field Hockey	21	25	32	48	18	17
Glee Club	29	28	46	32	34	33
Golf	21	24	32	35	36	35
Instrument	44	40	59	68	30	33
Knitting	27	21	23	39	33	35
Soccer	19	41	18	55	30	23
Social Dancing	33	26	32	61	40	42
Swimming	41	57	77	74	56	62
Volleyball	44	50	59	32	48	32

paring these activities in which they have had instruction with their participation, we find that basketball is seventeenth in rank of participation for universities, fifteenth in teachers colleges, seventeenth in state colleges, eighteenth in liberal arts colleges. Baseball is only slightly higher than basketball in participation, perhaps due to summer participation. Volleyball is fourteenth in participation rank in universities, eighteenth in teachers colleges, eighteenth in state colleges, and seventeenth in liberal arts colleges. Swimming shows the closest relationship between instruction and participation: eighth in universities and teachers colleges, tenth in state colleges, and fifth in liberal arts colleges.

Examination of Table VII, the percentage of students who would like to participate in activities, will show individual sports ranking very high.

Considering the entire group, archery is found to be high in student desires. In each group, golf also ranks high—in the 40 and 50 per cent. Sailing is high in all institutions, and especially in liberal arts colleges. Skiing, ice skating, canoeing are next in order, and are also high.

From responses given regarding the activities in which students would like instruction, the following are the highest: golf, riding, skiing, swimming, diving, and sailing.

It is interesting to compare this list with those activities in which students have had instruction. Such a comparison reveals swimming as the only duplicate activity. Apparently in swimming there is a greater desire for advanced instruction than in any other activity. Aside from swimming, none of the activities desired is included in the average program.

In comparing this same list with those activities in which students participate, no relationship appears, swimming being the only activity from this list which appears among the twenty-two activities highest in participation. Bicycling, camping, and hiking, three activities which are high in participation and desires, are notably low in desire for instruction. In contrast to the participation rankings which place home recreation and reading high, students' desires are turned toward more active outdoor sports.

It is interesting to note also that the entire list of activities in which students desire instruction, especially archery, golf, sailing, skiing, ice skating, and canoeing, is made up entirely of activities well adapted to mixed groups of men and women students.

A special study was made of dating as a recreational interest, and it was broken down to seven more specific units to give it more meaning. These divisions were (dating): at home; attending sports events; attending movies; attending plays, concerts, etc.; attending parties and dances; participating in sports; and riding in a car.

"At movies" and "at parties and dances" rank the highest in all

TABLE VII
PERCENTAGE OF STUDENTS WHO WOULD LIKE TO PARTICIPATE IN ACTIVITIES

Activity	Universities				Teachers Colleges				L. A. Colleges				State Colleges			
	Fr.	Soph.	Jr.	Sr.	Fr.	Soph.	Jr.	Sr.	Fr.	Soph.	Jr.	Sr.	Fr.	Soph.	Jr.	Sr.
Total Number of Students	325	220	91	84	270	214	25	26	221	135	74	50	400	192	52	31
Archery	45	14	44	47	51	50	40	46	48	45	42	26	53	61	52	58
Badminton	27	34	37	30	21	29	52	46	45	39	32	14	22	21	23	16
Basketball	29	34	32	25	33	34	40	38	38	36	31	32	34	33	19	32
Bicycling	42	36	37	49	43	46	64	31	44	43	41	42	37	36	40	55
Camping	36	32	26	27	34	41	48	31	45	44	48	28	33	41	27	26
Canoeing	17	50	43	39	50	48	56	38	54	57	54	12	46	47	42	42
Clog and Tap	29	27	28	32	39	40	40	27	40	47	39	30	35	35	33	32
Diving	36	39	31	45	38	38	48	31	51	49	43	24	40	48	35	36
Fencing	25	38	45	31	24	22	37	27	49	41	39	22	27	31	27	32
Golf	42	40	46	42	40	45	44	31	57	55	49	42	46	47	42	55
Hiking	38	25	20	21	25	32	44	27	42	37	34	24	33	33	27	13
Horseback Riding	21	41	42	38	37	41	56	42	50	53	58	38	51	49	42	52
Ice Skating	39	39	39	39	45	43	52	38	46	46	45	36	49	49	40	52
Rifle	34	34	32	27	36	31	40	31	35	40	43	26	37	35	39	36
Rowing	38	38	30	27	34	38	56	27	47	46	41	4	39	41	33	36
Sailing	38	49	41	44	47	46	56	42	64	61	60	18	43	51	35	36
Skiing	38	41	50	44	46	40	44	50	51	49	46	28	39	41	40	39
Social Dancing	34	32	24	24	33	33	40	23	34	31	26	12	38	37	31	45
Swimming	40	40	33	29	42	36	48	31	36	43	39	38	49	46	39	45
Trips	34	33	18	36	33	39	68	34	36	37	34	22	38	37	27	23

	Minnesota*				Stephens*	
	Fresh.	Soph.	Jr.	Sr.	Fresh.	Soph.
Total Number of Students	63	68	22	31	106	98
Archery	46	44	41	45	38	38
Bicycling	21	37	41	42	43	34
Bowling	35	36	36	39	39	27
Camping	25	47	46	26	42	33
Canoeing	29	46	59	26	42	34
Clog or Tap	19	40	27	32	31	26
Cooking	27	29	41	23	32	27
Dance Parties	21	34	32	29	38	23
Diving	32	41	36	35	38	30
Entertaining	25	29	41	23	32	27
Fencing	30	35	23	35	34	18
Golf	40	44	36	35	43	33
Hiking	16	38	41	16	37	25
Horseback Riding	49	46	59	42	47	31
Ice Skating	21	41	32	35	39	21
Knitting	29	32	55	48	26	24
Photography	24	46	39	52	30	23
Rowing	25	40	32	23	28	21
Sailing	43	62	64	45	40	38
Skiing	21	38	46	35	37	36
Social Dancing	24	38	27	32	37	27
Swimming	24	47	32	42	48	30
Trips	27	41	36	29	38	22

four types of institutions. Participating in sports, however, is relatively low. If student desires for activities were satisfied (golf, archery, ice skating, riding, sailing, etc.) the percentage of participation in sports events with dates might be raised. Noting the high percentage, also, of dating at home, and remembering the list of activities in which students have had instruction (basketball, volleyball, swimming, baseball, clog and tap) it would seem that very few, if any, of the activities which students learn in physical education classes can be continued in mixed home recreation.

An additional study of interest in clubs recorded low percentages, on the whole, when one considers the number of clubs known to exist. The highest percentage of membership in universities, teachers colleges, and state colleges is in social sororities. Other clubs high in percentage of membership are Y.W.C.A., music, protestant church clubs, and W.A.A. Further investigation shows that desires for membership, the clubs to which the students would like to belong, are almost exclusively limited to sports clubs.

In a special study of the physical education activities in which students would like to participate, certain activities were found to be noticeably low. These were: aerial darts, clock golf, handball, paddle tennis, tether ball, track and field, tumbling, lacrosse, and speedball. In the case of all the activities except track and field and tumbling, the percentage of those who had had instruction was also low.

CONCLUSIONS

The above interpretation of the data collected is in many ways inadequate. Although general trends have been noted, it is hoped that further study will clarify these ideas and give, in addition to group analysis, a more accurate picture of the individual and the range of her recreational interests and activities. From this study, however, it becomes evident that:

1. The highest participation is in inactive and indoor forms of recreation. The desires expressed, however, are for more active, outdoor sports.
2. Surprising similarity can be noted in the recreational interests in students of the four types of institutions. This statement was also confirmed by Johnson's specific study of two atypical schools.
3. The list of recreational interests among college women closely resembles the list published by the National Recreation Association regarding the leisure of five thousand people.
4. Living conditions in terms of home and abroad appear to have very little effect upon the character and extent of recreation.
5. No general statements can be made regarding the effect of hours of work on recreation. It appears to depend to a great extent upon the individual.
6. In general, the activities which have been taught in physical

education classes have been organized team games (swimming being an exception).

7. The activities desired by the highest percentage of students are individual activities and are all adapted to use in mixed recreation.

8. Activities desired by the greatest number of students are generally those which would probably be available only if provided for by the institution.

SUGGESTIONS

Further studies on the following problems are suggested from the data:

1. Analysis of individual questionnaires to discover range of recreational interests.

2. Study of major department and its relationship to recreational interests.

3. Comparison of participation and interest in indoor and outdoor activities.

4. Further analysis of those activities in which interest decreases during college years.

5. Interviews to check results.

6. Study of the communities from which these students come.

7. Special study of summer activities.

8. A study of graduates to determine their recreational participation.

9. Further analysis of institutions here studied to determine whether student desires are possible in their environment.

10. Study of the relationship of activities, i.e., what activities are associated together in the individual's recreation pattern.

BIBLIOGRAPHY

1. *The Leisure Hours of Five Thousand People*. A report of a study of leisure time activities and desires. (New York: National Recreation Association, 1934.)
2. Saxman, Ethel Julia, *Student's Use in Leisure Time of Activities Learned in Physical Education Classes in State Teachers' Colleges*. (New York: Teachers College, Columbia University, 1926.)
3. Craig, H. W., "Sports Interests and Attitudes of Students in the Service Curriculum at the University of Illinois," (Unpublished material.)
4. Cameron, Fred E., "Leisure-Time Activities of Business and Professional Men in Iowa," *RESEARCH QUARTERLY*, 6:3 (October 1935) 96-98.
5. Stuhr, Elsie J., "Interests and Abilities as a Basis for Program Planning," *RESEARCH QUARTERLY* 7:2 (May 1936) 92-98.
6. Waggoner, Miriam, "Individual Differences in Interests and Efforts of College Women as Related to a Program of Physical Education," *RESEARCH QUARTERLY*, 6:3 (October 1935) 86-95.
7. Lee, Mabel, *Conduct of Physical Education*, (New York: A. S. Barnes and Co., 1937).
8. Wiedemann, Inge, and Eugene Howe, "Undergraduate Attitudes and Interests with Regard to Physical Education Activities at Wellesley College," *RESEARCH QUARTERLY*, 8:1 (March 1937) 15-32.
9. Johnson, Helen A., "A Study Comparing Recreational Activities of College Women in a Large City University and a Small City Women's Junior College," (unpublished master's thesis, University of Iowa, June, 1938).

Health Problems of the Self-Supporting Student

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THE health of the working student has not been subject to very much investigation. The publications on student health during the past fifteen years show a very acute scarcity of articles on this phase of the work. During this period we have only been able to find one full article and scattered bits of information. Therefore, this discussion is based partly on the meager references in the literature and partly on our personal experience in student health work which by no means has been very extensive.

The first question that must obviously be discussed is whether or not the health status of the self-supporting student is any lower than that of the rest of the student body. Bradshaw studied the health records of 1,673 students entering Oberlin College in September, 1926, and continuing throughout the year.¹ Four hundred twenty of these students, or 25 per cent, were partially or wholly self-supporting. He found that of the self-supporting students 306, or 73 per cent, made 1,202 visits to the health service, or 2,862 visits per 1,000 persons as compared to 697 or 56 per cent of the independent students who made 2,515 visits or 2,007 visits per 1,000. Thus it is seen that the working students had 43 per cent more ambulatory illnesses. It might be said that ambulatory illness is not a good criterion for the comparison of the health status of these two groups since the working students, realizing the importance of keeping as fit as possible, may visit the health service much more frequently and for many more minor conditions than the non-working students. However, we find this same sort of disparity when we consider hospital illnesses. The self-supporting group spent 37 per cent more days in the hospital than the independent students. In this connection it is interesting to note the variation between the sexes. The 233 self-supporting men had a rate of 657 hospital days per 1,000, while the independent men had a rate of 490; on the other hand, the self-supporting women spent 2,032 days per 1,000 as compared to a rate of 1,197 for the independent women—a difference of 835 days per 1,000 women. There is no doubt, therefore,

* Presented at the Sixth Annual Meeting of the Mid-Atlantic Section of the American Student-Health Association, Charlottesville, Va., April 8, 1938.

¹ L. W. Bradshaw, "Health of the Self-Supporting College Student," *J.A.M.A.* 90 (June 2, 1928) 1775-6.

that the health status of the working student is lower than that of the student in better financial circumstances.

What then are his health problems? It is our opinion that the most important health hazard of this group is chronic fatigue. In addition to lack of sleep and the physical energy which must be spent on his job, the college life of the working student is monotonous, his daily program has in it more routine, and his responsibilities are more numerous. This combination of factors leads to chronic fatigue and in turn this condition expresses itself in a variety of ways. The greater number of minor and major health problems may be traced to it. Headache, muscular soreness and pain, flabby musculature, subnormal temperature, low blood pressure, dizziness, disturbed and restless sleep, capricious appetite, loss of weight, lowered mental tone, nervous instability, and many other minor complaints are expressions of this condition. In addition to this, there are some important problems which deserve mention.

The body resistance of the individual with chronic fatigue is obviously very low. Thus he easily falls prey to the acute respiratory infections, and so the incidence of this condition appears to be higher in this group. In the Oberlin study, the self-supporting students had a rate of 595 upper respiratory infections per 1,000 individuals as compared to 436 for the independent students. This is a difference of 36 per cent. Here again these figures must be taken with a degree of reservation. Working students with respiratory infections may visit the dispensary more frequently than independent students. Smiley, in 1924, showed that the majority of respiratory infections are not reported to the health service.² Incidentally, it was shown in this same study that tobacco, dust, gas, sleep, constipation, drafts, foot wear, bathing, perspiration, and mouth breathing do not seem to play an important part in the incidence of colds. Nevertheless, it is agreed that body resistance is important in determining susceptibility to respiratory infections, and no doubt these conditions must be more prevalent in self-supporting students.

In discussing body resistance, one necessarily thinks of tuberculosis. Various reports on the incidence of tuberculosis in the different colleges and universities were reviewed in order to discover whether or not mention was made as to the frequency of the disease in the group of working students. In none were we able to find this information. Although we do not have any statistical data with which to support our contention, it is our opinion that tuberculosis is no more frequent in this than in any other group. The disease is only important in so far as the management of the latent lesion is concerned. The student

² D. F. Smiley, "A Study of Acute Infection of the Throat and Respiratory System," *J.A.M.A.* 82 (Feb. 16, 1924) 540.

in good financial circumstances who is discovered to have such a condition may and does remain in school under supervision. This cannot be said for the working student. In practically all instances, he must withdraw and wait until the disease is arrested. This appears to be the most important aspect of this subject.

Mental problems may also be a part of the symptom-complex of chronic fatigue. These may take a variety of expressions depending upon the mental pattern of the individual. The inability to maintain a high level of nervous energy because of lack of sleep, worry, and other factors may cause instability, pessimism, a loss of health desire and satisfaction, nervousness, mild neuroses, and myriads of other maladjustments. A recent investigation of Raphael is worthy of note.³ Five hundred twenty-six individual students, 411 men and 115 women, were seen because of some mental problem. In 14.9 per cent the primary factor in precipitating the presenting situation was fatigue, and in 14.6 per cent pressure of outside work was either the primary or secondary factor.

Even suicide or the development of a suicide complex may be traced to chronic fatigue. Raphael, in another study of 3,021 college students, found that in 313 or 10.2 per cent suicide or the possibility of suicide was an important element in the specific case situation.⁴ In 14 cases, fatigue was a precipitating factor; and it was of primary or of immediate significance in the development of this complex in 81 cases.

The discussion of mental problems would not be complete without a word about the problem of inferiority complex in the working-student group. There is no doubt in our mind that the feelings of inferiority are more commonly found in this group. This is also borne out by a study of Gardner and Pierce.⁵ They showed that 53 per cent of the men and 65 per cent of the women who earn their expenses in part or whole were in the group confessing inferiority and the individual cases exhibiting such feelings in marked degree were almost invariably found to be in those earning from 60 per cent to 100 per cent of their college expenses. This was especially true among the women students.

Another group of health problems are those which are specifically concerned or inherent in the particular job in which the student is employed. This is a motley group which varies with each type of work or working condition. For instance, students working as postal clerks may suffer from eye strain, those in pressing establishments may report

³ T. Raphael, "The Question of Suicide as a Problem in Mental Hygiene," *Am. J. Orthopsychiatry*, 7 (Jan. 1937) 1-14.

⁴ T. Raphael, "Four Years of Student Mental Hygiene Work at University of Michigan," *Mental Hygiene*, 20 (April 1936) 218-31.

⁵ G. E. Gardner, and H. D. Pierce, "Inferiority Feelings of College Students," *J. Abn. Psychology* 24 (April-June 1929) 8-13.

burns or varicosities of the veins, while waiters may visit the infirmary for painful shoulders or feet. This group of health conditions does not offer a very great burden.

SUMMARY

The health of the self-supporting student is poorer than that of financially independent individuals. The most important health problem is chronic fatigue. It would be of value and interest to investigate further this whole problem, even to the extent of determining the effects of fatigue on the health of these students in late years after they have graduated. This might throw some light on the etiology of the degenerative diseases such as cardiovascular impairment, chronic nephritis, and cerebral thrombosis.

Safety Education as Provided in Elementary and High School Courses of Study of Large Cities

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HISTORY OF ORGANIZED SAFETY EDUCATION

PUBLIC schools have given attention to safety education in varying degrees since 1845. In the beginning, the emphasis was placed largely on remedial measures in the nature of first aid following accidents. Gradually schools began to emphasize prevention as related to individual health. By 1913 accident prevention was distinctly stressed. However, it was not until 1922 that serious efforts were made to develop a national safety education program.¹ Since 1922 the activity has progressed until today the scope of the movement, as fostered by schools and various civic bodies, has broadened from one of remedial measures and accident prevention to one of an important aspect of citizenship and conservation.²

While the safety education movement has been extended, the great social and economic complexity of the present age has multiplied daily hazards. The school as the agent of society has, in some measure, met the demand for systematic instruction regarding these hazards. Yet the definite need for the development of a more active safety consciousness in individuals is made apparent from a consideration of accident statistics.³ A study of statistics concerning children five to fourteen years of age, the group which has received the most systematic safety instruction in the schools, reveals the fact that material progress has been made.

The need for increased attention to safety in the public schools is evidenced by the fact that instruction in safety is required by law in eleven states. California, Connecticut, Indiana, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Tennessee, Wisconsin, and Wyoming have legislated for direct safety education. In North Carolina, Oklahoma, West Virginia, Michigan, and Minnesota there are

This paper is an abstract of a thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts, Division of Social Sciences, University of Chicago.

¹ *Accident Facts* (Chicago: National Safety Council, Inc., 1937) 4.

² Sidney Williams and M. B. Hillegas, "Realization of the Educational Aspect of the Problem," *The Present Status of Safety Education*, Twenty-fifth Yearbook of the National Society for the Study of Education, Part I. (Bloomington, Illinois: Public School Publishing Company, 1926) 22.

³ *Accident Facts*, pp. 4, 6-8, 10, 14.

indirect laws pertaining to safety education.⁴ Whether or not the schools in these states have met the need cannot be judged by existence of legislation requiring instruction. It is very evident that some cities in states that have no legislative requirements are carrying on excellent safety activities.

PURPOSE OF THE STUDY

The purpose of this study is to ascertain the present status of safety education in public elementary and high schools of thirty-five cities in the United States with a population of 100,000 or more through an analysis of elementary and high-school courses of study, handbooks, and outlines for study.

The chief aims in the analysis are:

1. To determine the general and specific objectives of safety education.
2. To determine the means or methods by which the objectives are attained.
3. To determine the place and importance of safety education in the curriculum.
4. To determine the general trends in safety education.

PROCEDURE

Letters were sent to the office of superintendent of schools in 37 selected cities of 100,000 population or more that were known to have courses of study in safety. In order to make certain that no outstanding courses were missed, cards were sent to the remaining 56 cities with a population of 100,000 or more. Of the 93 school systems contacted, 53 replied and 36 courses of study were forwarded. Twelve other courses were obtained at libraries.

When the contents of all courses were analyzed and compared chiefly as to objectives, organization and administration plans, three methods were used in presenting the facts, namely:

1. Descriptive analysis.
2. Statistical comparison to determine the relative importance of the items included, such as objectives, activities, etc.
3. Reference. The opinions of experts were drawn upon in the interpretation of the facts.

ANALYSIS

Introductory Statements.—The information given in the introductory statements included in nineteen of the twenty-five elementary courses and sixteen of the nineteen high school courses varies from the stereotyped material of such sections to that of a more acceptable nature, such as, significance of the subject, scope of the course, general

⁴ F. R. Noffsinger, "Status of Safety Education in the United States." (Washington, D. C.: Safety and Traffic Engineering Department; American Automobile Association, 1937, mimeographed) 1-19.

suggestions to the teacher, attention to school safety patrol, plan for administration, startling statistics, general objectives, basic views on subject.

Organization and Classification of Objectives.—While there is lack of uniformity in the use of the term "objective" and in the form of statement, there does not appear to be any variation in the idea of the meaning of an objective in the twelve elementary and seven high school courses which definitely state general objectives and the six elementary and five high school courses which mention them indirectly.

The general objectives of the various courses are of four types, namely: Group A, those that have to do with the individual and his personal safety; group B, those concerning the responsibility of the individual for the safety of others; group C, those concerning the broader aspects of safety in the community and nation; and group D, those that are too general for any definite classification.

Both the elementary and high school courses give the greatest emphasis to the phase pertaining to the personal safety of the individual. In the elementary grades, groups B, C, and D receive approximately equal emphasis. The high-school courses give second place definitely to group C which has to do with the broader aspects of safety.

Many of the courses examined do not distinguish between general and specific objectives and a few seem to confuse the two.

Eleven elementary and thirteen high school courses state specific objectives. Fourteen elementary and six high school courses give no specific objectives. Table I shows the method of organization of the objectives.

TABLE I

ORGANIZATION OF SPECIFIC OBJECTIVES IN ELEVEN ELEMENTARY AND THIRTEEN HIGH SCHOOL COURSES OF STUDY

Elementary	High School	Elementary	High School
<i>By Grades</i>		<i>Immediately before Subject Matter or Activities</i>	
11	1	4	6
<i>By Topics</i>		<i>Immediately after Activities</i>	
2	3	0	1
<i>By Subjects</i>		<i>Separate List</i>	
0	2	6	7

Specific objectives were classified in order to determine the various phases of safety treated. A study of the objectives in the elementary grades shows that they are directed toward the formation of correct habits and attitudes concerning safety in the home, school, street; and in recreation, health, fire prevention and fighting, civic safeguards, occupations, and miscellaneous activities. High school objectives treat one additional phase, that of automobile safeguards.

Table II clearly shows a wealth of different specific objectives in the high school courses as compared with the elementary. On the other hand, the elementary courses show a somewhat larger frequency of mention of objectives than the high school courses, indicating that in the lower grades it is the practice to repeat the various objectives in each grade in order to aid in habit formation.

Phases of Safety Treated.—Phases of safety education treated in the objectives of elementary courses ranked in order of frequency are: miscellaneous (personal and general), street, fire, recreation, health, home, civic safeguards, school, and occupations. When the objectives treating miscellaneous phases are separated into the two divisions, personal and general, the ranking is changed as follows:

Rank		Rank	
1	Street	6	Home
2	Personal (Misc.)	7	Civic Safeguards
3	Fire	8	School
4	Recreation	9	General (Misc.)
5	Health	10	Occupations

TABLE II

SUMMARY AND FREQUENCY OF CLASSIFIED SPECIFIC OBJECTIVES IN ELEVEN ELEMENTARY AND THIRTEEN HIGH SCHOOL COURSES OF STUDY

Phase of Safety	Elementary				High School			
	No. Different Objectives in Courses	Frequency of Mention	No. Courses	Rank	No. Different Objectives in Courses	Frequency of Mention	No. Courses	Rank
Home	14	42	9	6	46	54	4	3
School	8	16	7	8	19	21	3	8
Street	32	125	9	2	14	14	3	10
Recreation	25	65	10	4	27	28	5	6
Health	25	64	6	5	70	74	4	2
Fire	35	82	8	3	36	39	4	5
Civic safeguards	29	40	9	7	26	27	5	7
Occupations	1	1	1	9	19	19	4	9
Automobile safeguards	0	0	0	..	141	185	9	1
Accident prevention	..	..	..	..	39	52	..	..
Care of car	..	..	..	..	6	8	..	..
Operation of car	..	..	..	..	45	57	..	..
Traffic regulations	..	..	..	..	16	22	..	..
Pedestrian	..	..	..	..	4	5	..	..
General (driv. & ped.)	..	..	..	..	31	41	..	..
Miscellaneous	52	131	9	1	43	48	4	4
Personal	39	117	..	..	15	20	..	..
General	13	14	..	..	28	28	..	..
Totals	221	566	11	..	441	509	13	..

Children leaving the shelter of the home and the personal care of parents need to be instructed in how to care for themselves. It is necessary to train them in how to come to and go from school safely, to caution them against fire hazards, to instruct them how to conduct themselves in play, how to keep well and protect their health. Habits and attitudes of safety in places and situations which are most hazardous must be established and reenforced. Accordingly, objectives which concern the training of children in these most necessary phases of safety justly receive the most attention and hence are the highest ranking.

High school courses emphasize somewhat different phases of safety. The great many fatalities due to the automobile are the chief cause of the impetus given to safety education in the high school. Fourteen of the nineteen high school courses examined deal exclusively with automobile traffic safety. Consequently the great majority of objectives have to do with automobile safeguards. Other phases of safety are not neglected, however. Safety in health ranks second, with home, miscellaneous, fire, recreation, civic safeguards, school, occupations, and street safety following, consecutively. If the miscellaneous objectives are divided into the two divisions, personal and general, the rank changes as follows:

Rank		Rank	
1	.....Automobile Safeguards	5.5	.....General (Misc.)
2	.....Health	7	.....Civic
3	.....Home	8	.....School
4	.....Fire	9	.....Personal (Misc.)
5.5	.....Recreation	10	.....Occupations
		11	.....Street

The health phase of safety ranks second in high school courses chiefly because of the great amount of attention given to first aid. The emphasis placed on home safety is advisable when it is recalled that there were 38,500 home fatalities in 1936, non-fatal injuries to approximately 5,620,000 persons, and a resulting economic loss of about \$20,000,000.⁵ Junior and senior high school students have reached the age when they can take on some of the responsibilities for home safety. Fire is a hazard at all ages. Sports are an attraction during all seasons for high school boys and girls. The many hazards attendant need to be stressed with renewed vigor during the adolescent period when recreation is very often unsupervised.

Much more attention than appears in the ranking is given to civic safeguards in the junior and senior high schools as compared with the elementary grades. Many of the objectives classified under automobile safeguards, particularly accident prevention, traffic regulations, pedestrian, and general, are also civic safeguards.

⁵ *Accident Facts*, p. 54.

Occupational safety is treated in all but one of the general safety courses of study.

The objectives classified under the "street" phase are from the general safety courses, not those that deal with the automobile exclusively. Of course, many of the objectives included under automobile safeguards have to do with street safety.

There appears to be no one phase of safety that is treated in the objectives of all the courses, either in the elementary or high school grades.

Courses of Study Organization and Content.—The elementary courses follow the better practice in curriculum making,⁶ 72.39 per cent of the specific objectives being written in terms of the pupil's goal rather than the teacher's, while only 52.15 per cent of the high school objectives are expressed in those terms.

In the matter of course preparation also, more of the elementary courses than high school follow the best procedure. Committees of teachers and administrators prepared and organized the majority of elementary courses. Only seven high school courses definitely give credit to a committee of teachers and others for preparation.

Subject matter and activities are grouped largely by grades, topics, units, subjects, and objectives. A number of courses use a combination of methods. Organization by grade predominates in the elementary courses. The topical organization ranks first in the high school, with the unit type second, although there is but little uniformity in unit construction. There are almost as many types of so-called unit organizations as there are units. The few elementary courses which use the unit plan also exhibit lack of agreement as to the conception of a unit.

A frequency ranking of topics by grades shows a close relationship between objectives and topics and also a great amount of repetition, particularly from the kindergarten through the fifth grade. Grades six, seven, and eight emphasize similar topics. The two graded, general safety, high school courses studied treat topics similar to those emphasized in the first six grades. In the three that are not definitely graded, occupations is a leading topic. Since fourteen of the nineteen high school courses examined deal with safety for drivers and pedestrians, first place in the high school must necessarily be given to traffic safety.

Tables III and IV, respectively, show the specific objectives and topics with frequency rank by grades as found in elementary and high school courses. A comparison of the leading topics with the classified specific objectives shows a somewhat closer relationship in the elementary school. However, there is very likely a closer one in the high school than is evident from the table because of the fact that there were

⁶ Henry Harap, *The Technique of Curriculum Making*. (New York: The Macmillan Company, 1938) 28.

TABLE III
SPECIFIC OBJECTIVES AND TOPICS WITH FREQUENCY RANK BY GRADES AS FOUND IN
TWENTY-FIVE ELEMENTARY COURSES

Phases of Safety in Specific Ob- jectives	Topics						
	Kinder- garten— Primary	Fourth Grade	Fifth Grade	Sixth Grade	Seventh Grade	Eighth Grade	Not defi- nitely graded
1. Miscellaneous	1. Street	1. Fire	1. Fire	1. Civic S.	1. Civic S.	1. Civic S.	1.5. Street
2. Street	2. Fire	2. Street	2. Acci- dent	2. Fire	2.5. Acci- dent	2.5. Street	1.5. Home
3. Fire	3. Home	3. Home	3.5. Street	3. Street	2.5. Street	2.5. Home	3.5. School
4. Recreation	4. Play	4. Sea- sonal	3.5. Play	4.5. Acci- dent	2.5. Home	4. First Aid	3.5. Fire
5. Health	5. School	5. Acci- dent	5. Home	4.5. Health	4.5. Fire	5. Per- sonal (Misc.)	5. Play
6. Home		Pre- vention					
7. Civic Safeguards							
8. School							
9. Occupations							

TABLE IV
SPECIFIC OBJECTIVES AND TOPICS WITH FREQUENCY RANK BY GRADES AS FOUND IN
NINETEEN HIGH SCHOOL COURSES

Phases of Safety in Specific Objectives	Topics				
	Ninth Grade	Tenth Grade	Eleventh Grade	Twelfth Grade	Not definitely graded 7-12 Gr. Not definitely graded high school
1. Auto Safeguards	1. Acci- dent	1. School	1. Seasonal	1. Traffic- Acci- dent	1. Traffic- Acci- dent
2. Health	2. First Aid	2. Street	3.5. Fire		
3. Home		4. Home	3.5. First Aid		2. Occu- pations
4. Fire	4.5. Fire	4. Public	3.5. Occu- pations		3. Acci- dent
5.5. General (Misc.)	4.5. Home 4.5. Sea- sonal	4. Acci- dent	3.5. Per- sonal		4. Home 6. School
5.5. Recreation					6. First Aid
7. Civic S.					6. Play
8. School					
9. Personal (Misc.)					
10. Occupations					
11. Street					

only a few such courses with topics graded definitely, and so much of the work is listed under different subjects for correlation rather than under topics. Attention is called to the fact that all first-aid specific objectives were classified under health.

Provisions for Individual Differences.—Individual differences are provided for in the treatment of all phases of safety chiefly through the extensive provision for both mental and active experiences. Activities providing experiences for both elementary and high school students may be classified as follows:

Elementary School

Games, such as, Circle Squat, Magic Carpet, Dodgeball.
Excursions, such as, to the zoo, fire engine house.
Dramatizations, such as, how to put in a fire alarm; the lost child.
Collections, such as, insects, accident pictures.
Drawings, such as, safety posters, maps, graphs, charts.
Projects, such as, Safety Scouts, lantern slides.
Construction, such as, Safety Town, Mr. Safety's home.
Demonstrations, such as, how to care for a bonfire; how to bandage.
Miscellaneous, such as, singing, reciting safety rhymes, flying squadron safety talks.

High School

Excursions, such as, a visit to department store, factory, hotel, restaurant, garage, traffic court.
Dramatizations, such as, my first drive alone, actions of pedestrians, trial for manslaughter.
Collections, such as, advertising material to show what is being done with the question of safety by insurance companies, auto clubs, railroads, etc.
Drawings, such as, painting a safety zone around machines in shops, cartoons.
Projects, such as, Safety Council, Motor Club, traffic courts.
Construction, such as, costumes and scenery, model garage.
Demonstrations, such as, how to rescue a person from a burning building; artificial respiration.
Surveys, such as, the number of pupils who have been in traffic accidents during the past six months; the number of cases in which disregard for one or more laws was in any way responsible for the accident; locate "blind corners" in community.
Miscellaneous, such as, driving tests, interviews.

Teacher Procedure Aids.—In some courses, activities are only briefly noted or listed, while in others they are given in great detail. The elementary courses include many helpful, illustrative lessons. Projects are described and illustrative lessons on various topics and for several grades are included. High school courses fail to list sample lessons. However, a number are a combination text and course of study.

The activities necessary to accomplish the objectives are present in a majority of the courses.

Procedures other than illustrative lessons are also included. Some suggestions to aid procedure are of a very general nature. Others are very specific, including stenographic reports on how activities were carried on.

With few exceptions, the courses using the "unit" plan of organization fail to include definite understandings, problems, procedures, and activities in accordance with the best practice in unit organization.

Format of Courses.—The general style of the courses of study was the final item considered in the organization plans. A larger percentage of elementary courses than high school are in printed form.

It is evident that elementary courses favor the presentation of all material for one grade as a unit with the outline plan ranking second. In the high school courses the outline and text-course arrangement are favored. The latter plan is the trend in the newest traffic courses. The subject matter is discussed informally, generally in so-called units or lessons, followed by questions for discussion, activities, and references.

Plans for Administration.—Administration plans, as revealed in the courses, were considered after a study of the plan of organization. Without exception, the elementary courses indicate that the work in safety should be correlated with the regular subjects or extra-curricular work of the school day.

Although the trend in the secondary school is toward courses dealing with traffic safety taught as separate subjects giving minor credit, all of the courses in general safety for the high school, as well as the elementary, and thirteen of the traffic safety courses, suggest correlation with the regular subjects.

Table V shows that more recommendations for correlation with English than any other one subject are found in the elementary courses. High school courses recommend home economics and industrial arts most frequently, with social studies a close second. Such practice is in keeping with the recommendations of safety experts. However, too many courses recommend correlation with such subjects as arithmetic and handwriting which can contribute little that is fundamental.

The courses in traffic safety and driving in use in six cities definitely indicate that the work is taught as a "distinct unit" in connection with some regular subject. Other cities are known to present the work in this manner, although their courses do not so indicate.

Recommendations for the amount of time to be spent on safety topics are the exception rather than the rule. Eight elementary and high school courses include suggestions which vary from one lesson a week in correlation with other subjects to forty class periods.

Chief among administrative aids to safety education mentioned in

elementary courses of study is the Junior Safety Council. Some courses casually mention this organization while several give detailed plans for the organization and administration. Other administrative aids mentioned specifically in the elementary courses are: School safety patrol, school safety committee, Parent-Teacher Association, American Red

TABLE V
RECOMMENDATIONS FOR CORRELATION OF SAFETY EDUCATION
WITH OTHER SUBJECTS

Subject	Number of Recommendations	
	Elementary	High School
English	11	5
Drawing or art	10	2
Social studies (or social science)	9	6
Home economics and industrial arts ..	8	7
Arithmetic or mathematics	7	1
Health	7	4
"Regular subjects"	6	0
Reading	6	1
Penmanship	5	0
Geography	4	0
Civics	4	3
Language	3	1
Handwork	3	0
Nature study	3	0
Physical education	3	3
Science	2	5
Dramatics	2	0
Auditorium	2	0
Citizenship	2	0
Assembly	2	0
Music	2	0
Spelling	1	0
Composition and grammar	1	0
Physiology and hygiene	1	0
Activity programs	1	0
Extra-curricular	1	2
Agriculture	0	1
Commerce	0	1
Community life problems	0	1

Cross, assemblies, campaigns and drives, safety club, safety court, and visual education.

Few details concerning administrative aids are given in the high school traffic courses. The general safety high school courses are more specific in their recommendations. The Safety Club is mentioned most frequently. In addition to those mentioned in the elementary course, school newspapers and the library are suggested as aids in the high school.

Agencies outside of the school recommended as being helpful in the teaching of safety in all grades are: the Parent-Teacher Association,

city safety councils, state and city automobile clubs, allied charities, Police, Fire, Health, and Welfare Departments, State and National Forest Service.

SUMMARY AND CONCLUSIONS

The purpose of this study is to ascertain the present status of safety education in public elementary and high schools of 35 cities in the United States with a population of 100,000 or more through an analysis of elementary and high school courses of study, handbooks, and outlines for study.

In response to letters and cards sent to the office of superintendent of schools in 93 cities with a population of 100,000 or more, 36 courses were received. Twelve others were obtained at libraries.

Descriptive analysis, statistical comparison, and reference are the three methods used in presenting the facts.

Safety education is provided for through courses of study in at least 47 per cent of the 93 cities in the United States with a population of 100,000 or more. Fifteen cities which supplied no course of study, ten of which have none, report that they are carrying on very definite work along this line.

From the analysis of twenty-five elementary and nineteen high school courses, the following general conclusions are drawn:

1. *Objectives.*—Many of the courses do not distinguish between general and specific objectives, thereby causing some confusion. The recent courses are more consistent in the inclusion of specific objectives. In the lower grades it is the practice to repeat the various objectives in each grade in order to aid in habit formation. Elementary courses, more often than those for the high school, follow the better practice in curriculum making in expressing objectives in terms of the pupil's goal. General safety is the objective of elementary course makers. Traffic safety is the outstanding objective of makers of high school courses. Proper emphasis seems to be placed on the phases of safety which need the most attention, judging from statistics for fatal accidents in different age groups as compiled by the National Safety Council.⁷

2. *Organization Plans.*—Some courses show evidence of having given attention to scientific investigations, studies, and reports and have selected and organized the material according to the principles arrived at through research.

Good technique in curriculum making has been followed in the preparation of more elementary than high school courses in that the majority of the former are organized by committees. One fault results from such procedure. The same committee often does not prepare the course for all grades and as a result the terminology, plan of organiza-

⁷ *Accident Facts*, pp. 12-15.

tion, and arrangement of materials and activities for the various grades are not uniform. This does not make for easy use of the course and can be very annoying to a teacher, particularly in this day when many teachers rotate in the various grades.

The prevailing plan of organization followed by elementary course makers is the grade grouping, while high school organizers prefer the topical.

There is lack of agreement as to the conception of a unit, the type of organization which seems to be coming to the front in the most recent elementary and high school courses. Organizers using the unit plan are not careful to include definite understandings, problems, procedures, and activities in accordance with the best practice in unit organization.

Close relationship between objectives and topics is exhibited in the majority of elementary and high school courses. The content material provided and suggestions for active as well as mental experiences, if carried out by effective teaching, should result in the realization of the objectives.

Individual differences are provided for in most courses through the various activities suggested.

Several courses are outstanding in aids provided for teachers and pupils.

The success with which the bodies of the courses carry out the introductory statements varies greatly.

The majority of courses are printed. There is evidence of experimentation before adopting the course of study which accounts, no doubt, for the mimeographing of some. In some cases, however, the experimental stage is rather long. Tentative courses prepared in 1925 are still in use.

3. *Administration Plans.*—Safety topics are not generally taught as a separate subject. They are taught whenever and wherever situations arise and in correlation with regular subjects in elementary schools. The majority of high schools integrate safety with various subjects by devoting a definite period of time, varying from two weeks to forty periods, to the study of traffic safety particularly. Too many courses suggest correlation with subjects, such as arithmetic and handwriting, from which little of fundamental value can be obtained. Course makers would do better to correlate more of the safety work with health, geography, science, civics, home economics, and manual arts, which afford the richest contacts for safety.

Recommendations in courses of study for time to be spent in safety education in its several phases are few.

Authorities differ on administrative plans, but whatever plan is used, the school as the agent of society is required to assume the

responsibility for training in accident prevention as a protection against the unsafe environment created by modern society.

4. *General Trends.*—The most significant general trend is the upward extension of the safety education program to the high schools. Up to the present time the majority of cities have shown little disposition to articulate general safety instruction in the grades with the high school work. Automobile traffic safety is overwhelmingly the dominant phase of safety taught in secondary schools. However, two of the newest high school courses include all phases of safety, thereby providing the necessary articulation between the two schools.

Text courses of study in traffic safety are appearing in increasing numbers.

In connection with the emphasis on traffic safety, there is a trend toward the establishment of automobile driving courses in the high school and teacher-training courses in normal schools and universities. Pressure is being exerted to establish separate courses in safety, particularly in automobile driving. An introductory course is given in the first year of high school or the eighth grade, followed by organized study in the sophomore or junior year in correlation with one of the regular subjects, and completed by a practice and demonstration class in automobile driving in the senior year. That the satisfactory completion of such courses will be made a requirement for high school graduation seems probable.

The need for a high school course of study in safety is tending to make school officials examine more closely old elementary courses. As a result, the entire school safety program is being revised as it is extended.

A Critical Evaluation of Some of the Existing Means of Classifying Boys for Physical Education

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THE purpose of this study is to determine an administratively feasible procedure which shall produce more homogeneous classification of boys for physical education than that usually produced by existing means.

National surveys, state studies, and personal observation reveal that pupils are seldom classified for physical education except by grade and by sex. Leaders in the field are generally favorable to homogeneous grouping, usually for the purpose of making instruction in physical education more safe and more effective. Therefore it would seem that a study of means of classification is necessary.

Following an intensive survey of the literature, analyses of certain classifying factors were made by means of:

1. An experimental classification of 120 graphic representations of college men selected at random.
2. Profile studies of functional tests and the criterion measure.
3. Intercorrelations of each factor with every other factor and the criterion by institutional levels.
4. Multiple correlations of selected classifiers.
5. Administrative groupings by selected classifiers.

The preliminary and experimental graphic study seemed to reveal the inadequacy of alphabetical grouping (such as would result from assignment to class from study hall or free period) and of classification by Physical Fitness Index. McCloy's Classification Index gave indication of being more desirable than either of the above procedures. Primary grouping into Strength Index thirds and secondary grouping within these thirds by Classification Index made an observable improvement over any of the previous arrangements. Theoretically this administrative use of two classifying factors has the added advantage of providing for safety by grouping by hulk and maturity (Classification Index) and also for efficiency of instruction by grouping by a test of functional power (Strength Index). While each test might be said to be primarily of the nature just indicated, each is reported to be

This article is an abstract of a dissertation accepted in partial fulfillment of the requirements for the degree of Doctor of Education in the School of Education of New York University, 1939.

TABLE I
DATA OBTAINED FROM EACH INSTITUTION INVOLVED IN THE STUDY

Institutions	Factors												
	Age	C.I.*	F.I.*	G.A.A.*	Grade	Height	I.A.E.*	M.A.*	P.C.I.*	P.F.I.*	S.I.*	Weight	Total
Bloomington													
Bannaker	22	21			24	23		22				24	24
Central	40	35			38	36						36	40
Elm Heights	189	182			190	182	142	162		158	158	182	190
Fairview	147	113			151	114		117				115	151
Hunter	91	87			94	87		72				87	94
Junior High	340	335			349	341		216		319	319	341	349
McCalla	147	131			154	131		112				131	154
Saint Charles	38	38			38	38		37		35	35	38	38
Senior High	224	224			224	224	145	102		169	169	224	224
Indiana University	576	576	118	92		576	92	442	118	521	521	576	576
Normal College	55	55				55		55		55	55	55	55
Louisville													
Shawnee	509	509	497	497	509	509	497	499	496	497	497	509	509
Williams College	443	443			807	443				807	807	443	807
Missouri													
Kemper	390	390	358	330	390	390	335	105	356	362	362	390	390
Grand Total	3211	3139	973	919	2968	3149	1211	1941	970	2923	2923	3151	3601

* C.I.—Classification Index; F.I.—Force Index; G.A.A.—General Athletic Ability; I.A.E.—Individual Athletic Events; M.A.—Motor Ability; P.C.I.—Physical Capacity Index; P.F.I.—Physical Fitness Index; S.I.—Strength Index. Throughout this study these initials will stand for these same factors.

secondarily a measure of the other's function and accordingly tends to be supplementary.

Table I shows the sources and extent of the data utilized in this study.

Figures 1 and 2 serve further to indicate the range, size, and nature of the sampling of cases for the tests and measures employed. From these profiles an evaluation of the functional tests and measures of growth and development was made. The criteria employed in the selection of the desirable profiles were:

1. Regularity of progression and variability.
2. Range of discrimination.
3. Attenuation of the figure or absence of variation from the line of progression.
4. Approximation of the line of progression to the regression line in perfect correlation.

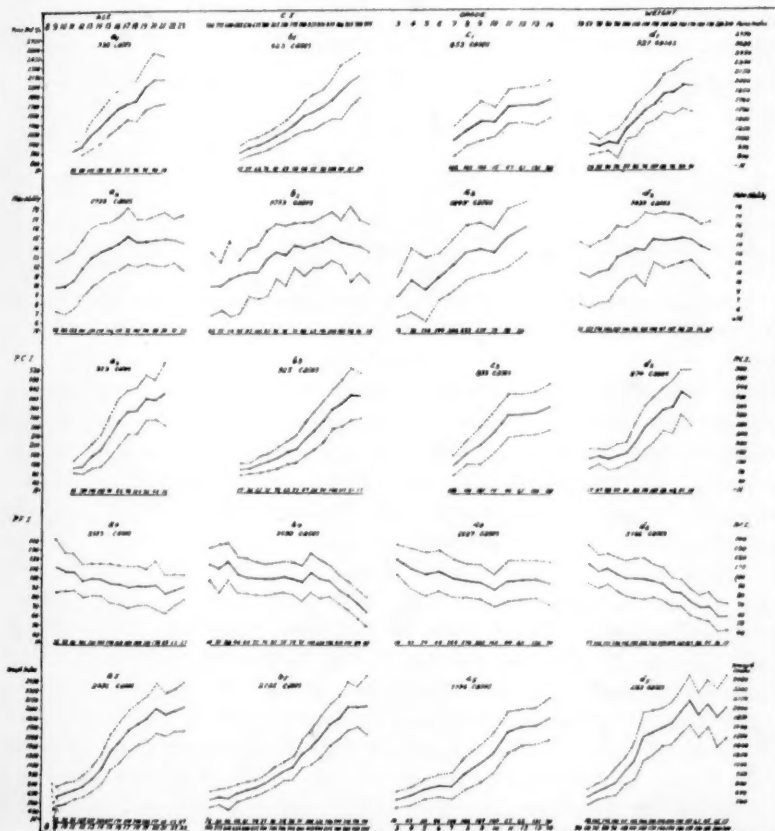


FIGURE 1. Profiles of functional tests and measures of growth and development.

All profiles in a figure have comparable vertical and horizontal ranges. The middle solid line is the profile of the averages in the observed measure for each interval of the measure of progression. The dotted lines either side of the average demarcate one standard deviation above and below the average. By the evaluative criteria Brace's Motor Ability Test and Rogers' Physical Fitness Index appear to be the least adequate functional measures. Grade and weight appear to be the least adequate growth and development measures. Force Index and Strength Index, progressed through Classification Index, seem to meet the criteria most satisfactorily. In Figure 2, the criterion score (total score on

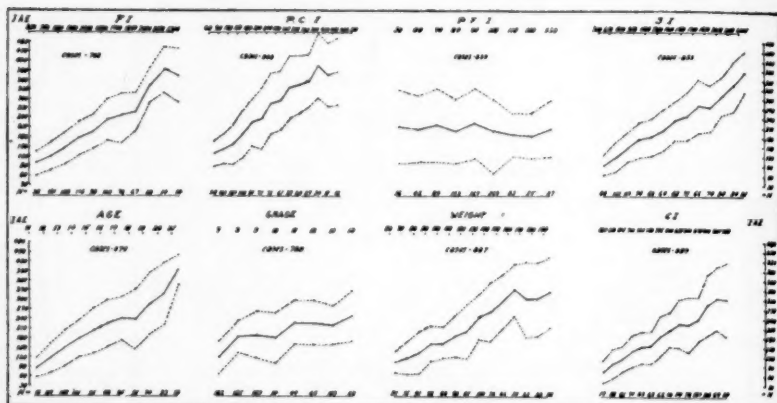


FIGURE 2. Profiles of criterion scores with functional tests and with measures of growth and development.

seven individual athletic events)¹ best meets the criteria for evaluating the profiles when progressed through Strength, a functional test, and Classification Index, a measure of growth and development. The criteria are least adequately met when the criterion score is progressed through the functional test, Physical Fitness Index, and the growth and development measure, grade.

Zero order correlations were obtained for each factor with every other factor and with the criterion in each institutional level (elementary, junior high school, senior high school, secondary junior college, and college). From the composite matrix of these correlations,² certain trends and tendencies are observable. Table III indicates the rank order of each factor as determined by the "squared r " method of averaging correlations. Strength Index ranks first in the middle three levels and fourth in the elementary and college levels. Classification Index ranks first in the elementary level, second in the junior and senior high

¹ The same events as were employed in Cozens' General Athletic Ability Test.

² See Table II.

TABLE II
COMPOSITE OF ZERO ORDER CORRELATIONS OF ALL DATA
RANKED BY SUCCESSIVE SCHOOL LEVELS

Age	C.I.	F.I.	G.A.A.	Grade	Ht.	I.A.E.	M.A.	P.C.I.	P.F.I.	S.I.	Wt.
Age	.845	...	...	.663	.512	.494	.194	...	—078	.558	.467
	.804	.622	.508	.743	.605	.564	.387	.599	.092	.651	.500
	.330	.291	.202	.510	.278	.221	.268	.294	.055	.480	.287
	.550	.412	.387	.724	.230	.334	.348	.375	—060	.434	.258
	.214	.451	.499	...	.098	.499	.076	.309	.012	.275	.213
C.I.	...	...	...	.557	.894	.373	.082	...	—269	.635	.800
	.744	.458	.652	.921	.594	.252	.704	—168	.835	.879	
	.448	.023	.337	.767	.237	.072	.295	—303	.593	.833	
	.461	.083	.404	.733	.204	—017	.361	—530	.384	.829	
	.438	.280	...	.801	.282	—141	.367	—533	.335	.883	
F.I.	...	...	...	...	...	...	...	...	...	...	...
	.543	.499	.742	.669	.351	.821	.129	.934	.773		
	.379	.211	.228	.453	.233	.665	.201	.827	.358		
	.396	.303	.237	.491	.253	.774	.158	.855	.409		
	.599	...	.232	.639	...	.760	.018	.769	.558		
G.A.A.	...	...	...	...	...	...	...	...	...	...	...
	.457	.437	.945	.527	.593	.313	.577	.276			
	...	.073	.894	.285	.553	.339	.512	.077			
	.273	.077	.943	.260	.564	.322	.563	—060			
	...	.168	.967	.299	.534	.079	.527	.213			
Grade	...	...	...	...	...	...	...	...	...	...	...
	.427	.347	.123	...	—145	.412	.307				
	.533	.487	.415	.513	.019	.514	.452				
	.183	.049	.377	...	.168	.447	.225				
	.155	.237	...	.280	—026	.323	.173				
Ht.	...	...	...	...	...	...	...	...	...	...	...
	...	.346	—024	...	—261	.587	.771				
	...	.535	.203	.639	.151	.787	.814				
	...	.032	—120	.241	.295	.411	.586				
	...	.129	.132	.224	—339	.269	.452				
I.A.E.	...	.190	—211	.236	—351	.195	.502				
	...	.508	...	.377	.579	.171					
	...	.518	.685	.217	.692	.449					
	...	.200	.572	.407	.705	.148					
	...	.344	.586	.314	.642	.036					
M.A.	...	.360	.602	.055	.587	.280					
	...	...	.202	.204	—049						
	...	.412	.280	.356	.139						
	...	.233	.414	.419	—090						
	...	.259	.313	.383	—122						
P.C.I.	...	...	.373	.322	—166						

	...	.159	.823	.603							
	...	.353	.540	.175							
	...	.258	.773	.277							
P.F.I.	...	.147	.750	.394							
	...	...	.474	—406							
	...	.203	—376	.757							
	...	.364	—492	.376	—663						
	...	.471	—589								
S.I.	...	...	...	.530							
	...	...	...	.757							
	...	...	...	.512							
	...	...	...	.448							
	...	...	...	.356							

levels, and fifth in the senior high-college and college levels. Force Index progresses from third rank in the junior and senior high school levels to second place in the secondary-junior college level and first place in the college level. Motor Ability ranks last in all levels but the junior high school in which level it ranks next to last. Grade is third from last in all levels for which data were available except in the senior high level in which it ranks next to last. Physical Fitness Index ranks next to last, last, third from last, fourth from last, and third from last in the several levels respectively.

Multiple correlations were computed in each level for selected factors. No multiple correlations were found to be high (.80 to .89)

TABLE III
RANK ORDER BY AVERAGE CORRELATION OF ALL FACTORS AS DETERMINED FOR EACH INSTITUTIONAL LEVEL BY THE "SQUARED r " METHOD*

Rank	Institutional Levels									
	Elementary		Junior High		Senior High		Secondary-Jr. College		College	
	Factor	Av. r	Factor	Av. r	Factor	Av. r	Factor	Av. r	Factor	Av. r
1	C.I.	.620	S.I.	.681	S.I.	.544	S.I.	.527	F.I.	.549
2	Ht.	.544	C.I.	.678	C.I.	.476	F.I.	.478	I.A.E.	.513
3	Age	.528	F.I.	.658	F.I.	.434	P.C.I.	.473	P.C.I.	.501
4	S.I.	.513	Ht.	.623	I.A.E.	.433	I.A.E.	.460	S.I.	.495
5	Wt.	.503	P.C.I.	.621	P.C.I.	.425	C.I.	.458	C.I.	.486
6	I.A.E.	.416	I.A.E.	.603	G.A.A.	.419	G.A.A.	.436	G.A.A.	.485
7	Grade	.411	Wt.	.592	Wt.	.412	Wt.	.414	Wt.	.466
8	P.F.I.	.304	Age	.581	Ht.	.360	Age	.385	Ht.	.358
9	M.A.	.224	G.A.A.	.538	Age	.342	P.F.I.	.353	P.F.I.	.338
10			Grade	.509	P.F.I.	.330	Grade	.338	Age	.313
11			M.A.	.367	Grade	.312	Ht.	.323	M.A.	.264
12			P.F.I.	.211	M.A.	.255	M.A.	.267		

* Henry E. Garrett, *Statistics in Psychology and Education* (1937) p. 284.

with the criterion except that of Strength Index and Classification Index ($R = .799$) in the senior high school level. The regression equation for this combination is:

$$X = .142 \times \text{S.I.} - .672 \times \text{C.I.} + 726.43$$

Subsequent grouping of criterion scores by the statistically combined measures indicates that this classification was the least desirable of all combinations employed in the senior high level. In general, the indications are that statistical combinations of a reasonable number of factors do not justify the added difficulty of administration and that they may be even less desirable than some measures employed alone.

The concluding technique of analysis is that of administrative grouping. In this procedure pupils are ranked from high to low in a primary classification factor. The total group is then broken into the desired number of equally-sized groups by count. (In this study three

equal groups were formed in each institutional level.) These primary groups are then each broken at the mean point into two ability groups by a secondary factor. In the present study this sub-grouping produced six groups, each relatively homogeneous in a primary classifying factor and in a secondary factor. Thus the blending or nullification of the effects of the separate measures, as is frequently found in statistical combinations, is avoided and the effect of each factor is retained in its purity by classification by one factor at a time.

Figure 3 exemplifies the procedure and the results in the recommended test or tests for each institutional level. The obtained numerical results will not necessarily be duplicated in other institutions or in certain localities, but the reliability of the findings seems to indicate that the same factors and techniques would be indicated in subsequent applications of the procedures employed in this study. The criteria employed in the selection of these four recommended procedures, in approximate order of importance, are: 1, highest correlation of classifying factors with the criterion scores; 2, regularity of increment in average criterion scores of successive groups; 3, significance of critical ratios for successive means; 4, largest average critical ratios (nine in each grouping); 5, largest average difference between criterion averages of successive groups; 6, ease of administration of the tests required; 7, grouping accounts for strength, velocity, and dead weight (these factors are shown by the literature to be essential); 8, least average coefficient of variation; and 9, the least correlation of the classifying factors with each other.

In summary, the findings seem to indicate that boys in the elementary school should be classified by Strength Index alone. A reasonable second choice would be to classify by Classification Index alone. (In each instance after health findings have been accounted for.) In the junior high school, the preferred classification is by Strength Index thirds and a secondary grouping by MacCurdy's Physical Capacity Index. A reasonable second choice was found to be Physical Capacity Index primary thirds and Classification Index secondary grouping. In the senior high schools the preferred grouping is by Strength Index alone, but a reasonable second choice would be to classify first by Strength Index and secondarily by Physical Capacity Index. In schools in which the junior and senior high schools are organized under the same roof, it would seem justifiable to classify all boys by the Strength Index-Physical Capacity Index procedure. In the college level the primary grouping by Force Index and secondary grouping by Strength Index is slightly preferable, although a satisfactory procedure would be the second choice, that of primary grouping by Strength Index and secondary grouping by Force Index.

Not only are the groups classified by these procedures more homogeneous with respect to performance in individual athletic events

BOYS' STRENGTH INDEX			
Up to 137		138 and up	
Total Scores In		Total Scores In	
Individual Athletic Events		Individual Athletic Events	
A.M. = 139.49 \pm 4.87		A.M. = 139.44 \pm 5.30	
C.T. = 41.94 \pm 5.18		C.T. = 41.00 \pm 5.18	
C.B. = $\frac{139.49}{41.94} = 3.33$		C.B. = $\frac{139.44}{41.00} = 3.40$	
F = 18.47		F = 17.77	
S = 12.77		S = 12.77	
C.B. = $\frac{18.47}{12.77} = 1.45$		C.B. = $\frac{17.77}{12.77} = 1.39$	
Total Scores In		Total Scores In	
Individual Athletic Events		Individual Athletic Events	
A.M. = 139.49 \pm 4.87		A.M. = 139.44 \pm 5.30	
C.T. = 41.94 \pm 5.18		C.T. = 41.00 \pm 5.18	
C.B. = $\frac{139.49}{41.94} = 3.33$		C.B. = $\frac{139.44}{41.00} = 3.40$	
F = 18.47		F = 17.77	
S = 12.77		S = 12.77	
C.B. = $\frac{18.47}{12.77} = 1.45$		C.B. = $\frac{17.77}{12.77} = 1.39$	

Figure 3. Administrative Groupings of Junior High School Boys Into Primary Thirds by Strength Index and Secondary Groupings of Primary Thirds at the Same by Secondary Strength Index.

BOYS' STRENGTH INDEX			
Up to 140		141 and up	
Total Scores In		Total Scores In	
Individual Athletic Events		Individual Athletic Events	
A.M. = 137.7 \pm 14.07		A.M. = 131.5 \pm 13.08	
C.T. = 41.94 \pm 5.18		C.T. = 41.00 \pm 5.18	
C.B. = $\frac{137.7}{41.94} = 3.28$		C.B. = $\frac{131.5}{41.00} = 3.21$	
F = 18.47		F = 17.77	
S = 12.77		S = 12.77	
C.B. = $\frac{18.47}{12.77} = 1.45$		C.B. = $\frac{17.77}{12.77} = 1.39$	
Total Scores In		Total Scores In	
Individual Athletic Events		Individual Athletic Events	
A.M. = 137.7 \pm 14.07		A.M. = 131.5 \pm 13.08	
C.T. = 41.94 \pm 5.18		C.T. = 41.00 \pm 5.18	
C.B. = $\frac{137.7}{41.94} = 3.28$		C.B. = $\frac{131.5}{41.00} = 3.21$	
F = 18.47		F = 17.77	
S = 12.77		S = 12.77	
C.B. = $\frac{18.47}{12.77} = 1.45$		C.B. = $\frac{17.77}{12.77} = 1.39$	

Figure 4. Administrative Groupings of Elementary School Boys Into Primary Thirds by Strength Index and Secondary Groupings of Primary Thirds at the Same by Secondary Strength Index.

BOYS' STRENGTH INDEX			
Up to 140		141 and up	
Total Scores In		Total Scores In	
Individual Athletic Events		Individual Athletic Events	
A.M. = 137.7 \pm 14.07		A.M. = 131.5 \pm 13.08	
C.T. = 41.94 \pm 5.18		C.T. = 41.00 \pm 5.18	
C.B. = $\frac{137.7}{41.94} = 3.28$		C.B. = $\frac{131.5}{41.00} = 3.21$	
F = 18.47		F = 17.77	
S = 12.77		S = 12.77	
C.B. = $\frac{18.47}{12.77} = 1.45$		C.B. = $\frac{17.77}{12.77} = 1.39$	
Total Scores In		Total Scores In	
Individual Athletic Events		Individual Athletic Events	
A.M. = 137.7 \pm 14.07		A.M. = 131.5 \pm 13.08	
C.T. = 41.94 \pm 5.18		C.T. = 41.00 \pm 5.18	
C.B. = $\frac{137.7}{41.94} = 3.28$		C.B. = $\frac{131.5}{41.00} = 3.21$	
F = 18.47		F = 17.77	
S = 12.77		S = 12.77	
C.B. = $\frac{18.47}{12.77} = 1.45$		C.B. = $\frac{17.77}{12.77} = 1.39$	

Figure 5. Administrative Groupings of Junior High School Boys Into Primary Thirds by Strength Index and Secondary Groupings of Primary Thirds at the Same by Secondary Strength Index.

BOYS' STRENGTH INDEX			
Up to 140		141 and up	
Total Scores In		Total Scores In	
Individual Athletic Events		Individual Athletic Events	
A.M. = 137.7 \pm 14.07		A.M. = 131.5 \pm 13.08	
C.T. = 41.94 \pm 5.18		C.T. = 41.00 \pm 5.18	
C.B. = $\frac{137.7}{41.94} = 3.28$		C.B. = $\frac{131.5}{41.00} = 3.21$	
F = 18.47		F = 17.77	
S = 12.77		S = 12.77	
C.B. = $\frac{18.47}{12.77} = 1.45$		C.B. = $\frac{17.77}{12.77} = 1.39$	
Total Scores In		Total Scores In	
Individual Athletic Events		Individual Athletic Events	
A.M. = 137.7 \pm 14.07		A.M. = 131.5 \pm 13.08	
C.T. = 41.94 \pm 5.18		C.T. = 41.00 \pm 5.18	
C.B. = $\frac{137.7}{41.94} = 3.28$		C.B. = $\frac{131.5}{41.00} = 3.21$	
F = 18.47		F = 17.77	
S = 12.77		S = 12.77	
C.B. = $\frac{18.47}{12.77} = 1.45$		C.B. = $\frac{17.77}{12.77} = 1.39$	

Figure 6. Administrative Groupings of Junior High School Boys Into Primary Thirds by Strength Index and Secondary Groupings of Primary Thirds at the Same by Secondary Strength Index.

but they are also reasonably homogeneous with respect to hulk and maturity as measured by McCloy's Classification Index. It is reasonable to expect that greater safety would result in classes so formed as well as increased efficiency of instruction since the boys will be structurally and functionally more homogeneous than is usually the case at the present time.

SELECTED BIBLIOGRAPHY

1. Billett, Roy O. "Provisions for Individual Differences, Marking and Promotion." The National Survey of Secondary Education. *Bulletin, 1932, No. 17, Monograph 13*. (United States Government Printing Office, Washington, D. C., 1933) 472 pp.
2. Bovard, John F., and Frederick W. Cozens. *Tests and Measurements in Physical Education*. (Philadelphia: W. B. Saunders Company, 1938) 424 pp.
3. Brace, David K. *Measuring Motor Ability*. (New York: A. S. Barnes and Company, 1927) 138 pp.
4. Brammell, P. Roy. "Health Work and Physical Education." National Survey of Secondary Education, *Bulletin, 1932, No. 17, Monograph 28*. (United States Government Printing Office, Washington, D.C., 1933) 98 pp.
5. Cozens, Frederick W. *Achievement Scales in Physical Education Activities for College Men*. (Philadelphia: Lea and Febiger, 1936) 118 pp.
6. Garrett, Henry E. *Statistics in Psychology and Education*. (New York: Longmans, Green and Company, 1937) 493 pp.
7. Lloyd, Frank S. "Safety in Physical Education in Secondary Schools." (Bureau of Casualty and Surety Underwriters, Educational Series, Vol. IX, New York, 1933) 167 pp.
8. MacCurdy, Howard Leigh. "A Test for Measuring the Physical Capacity of Secondary School Boys." (Published by the Author, 25 Parkview Avenue, Bronxville, N.Y., 1933) 59 pp.
9. McCloy, Charles H. *The Measurement of Athletic Power*. (New York: A. S. Barnes and Company, 1932) 178 pp.
10. Messer, Guerdon Norris. "Critical Analysis of the Application of Rogers' Physical Fitness Test to Williams College Students, the Establishment of Revised Normal Strength Indices for Williams College Men." School of Education, New York University, Ph.D. Thesis, New York, 1932.
11. Nash, Jay B. *The Administration of Physical Education*. (New York: A. S. Barnes and Company, 1931) 491 pp.
12. Rogers, Frederick Rand. *Fundamental Administrative Measures in Physical Education*. (Newton, Mass.: The Pleiades Company, 1932) 360 pp.
13. ———. *Physical Capacity Tests*. (New York: A. S. Barnes and Company, 1931) 50 pp.
14. ———. *Tests and Measurements Programs in the Redirection of Physical Education*. (Bureau of Publications, Teachers College, Columbia University, New York, 1927) 166 pp.
15. ———. "A Review of Recent Strength-Testing Literature." *Journal of Health and Physical Education*, 5:3 (March 1934) 8.

A Basketball Motor Ability Test for College Women and Secondary School Girls

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THE scientific measurement of basketball is extremely difficult. It is complicated by the fact that there is a large unmeasurable element in the game as a whole. Even with this handicap, however, the objective evaluation of basketball is worth attempting.

The obvious first step in the construction of a test is analysis of the activity to be measured. The skills necessary to success in basketball are of two general types. Strategic ability (the quality called, in general, athletic smartness), cooperative team play, tenacity, and a sense of timing are some of the intangibles which form one group of skills. The second type of skill is more or less purely motor. Included in this group are all the motor abilities involved in handling the ball and the body accurately, speedily and effectively in relation to the other players, and also the object of the game, that is, the scoring of more points than one's opponents.

Both types of skills are essential, although it is not yet known which, if either, is the more important, or in what proportions each is desirable. General observation has shown that the possession of high motor skills, alone, does not make a successful player. A person may be able to sink baskets continuously in practice, and yet not be able to score in a game. On the other hand, good strategic sense is worthless in a game if the player has such poor motor skill that she continually fumbles the ball. Whatever the relative importance of the two types of skill may eventually be determined to be, there can be no question but that the motor type of skill is of some considerable importance in determining general proficiency in basketball.

A review of the literature of basketball motor ability tests for women and girls* impressed us with the fact that there is no one test which has been validated and standardized for use throughout the total

* Numbers will be used to refer to the Bibliography at the end of this article. For the literature referred to here, see numbers 1, 2, 3, 6, 7, 8, 9.

basketball playing age range. All the available tests were constructed either for college women, high school girls, or for the junior high school level. None of them was constructed for all three levels. Some of them have been standardized with acceptable norms, and some have not.

There seemed to us to be a definite need for a basketball motor ability test which would be suitable to the entire basketball playing age range, validated for each of the school levels, and provided with adequate and comparable norms. The present study was, therefore, undertaken for the purpose of producing such a test. The project involved three separate problems, each of which will be discussed in order:

Problem I. Selection of test items to include in the basketball motor ability test.

Problem II. Investigation of the validity, reliability, and objectivity of the test.

Problem III. Construction of T-scale norms for the test.

SOURCES OF DATA

Data were obtained from four sources, on three levels: college women, high school girls, and junior high school girls.

A strong tendency was noted in the preliminary experiments for scores to be adversely affected when the tests were given just prior to or during the first part of the menstrual period. Time was not available for a thorough investigation of this tendency. Therefore, to avoid any possible invalidation of our data from this source, no one was tested the two days prior to, or the first two days of the menstrual period. All testing was done during the physical education periods regularly devoted to basketball.

Arnold Data.—Arnold College, New Haven, Connecticut. Approximately 40 women students majoring in physical education were available for testing each year, 1936–1939.

LaCrosse Data.—*LaCrosse State Teachers College, LaCrosse, Wisconsin. Scores were obtained from 25 senior and 44 freshmen women students, majoring in physical education during 1938–1939.

New Haven Data.—New Haven High School, New Haven, Connecticut. A total of 138 ninth, tenth, eleventh, and twelfth-grade girls were tested from 1937 to 1939.

Westport Data.—Bedford Junior High School, Westport, Connecticut. Scores were obtained from testing a total of 270 seventh, eighth, and ninth-grade girls from 1937–1939.

PROBLEM I

SELECTION OF TESTS FOR THE BASKETBALL MOTOR ABILITY TEST

The problem of the selection of test items for the basketball motor ability test was attacked in two ways. The mechanical aspects were

* Contributed by Miss Emma L. Wilder.

first studied, and it was decided that only such test items as met the following general criteria would be considered. Each item should be as objective as possible, be easy to administer and score, and require no expensive special equipment. The complete test should contain few enough subtests so that it could be administered to groups of from twenty to thirty players in forty to fifty minutes. These numbers and times were selected as the standard because most basketball classes are of that size, and most physical education periods are that long. Preliminary investigation showed that four subtests would be the maximum number which could be administered to college women within the prescribed limits. When the physical education time was less than forty minutes, where groups were larger than thirty players, and with the younger ages, two testing periods were found necessary.

The second approach to the problem of selection of subtests involved providing answers to three questions. Of what special motor skills is basketball motor ability composed? What tests may be found, or constructed, to measure these skills? How many subtests are needed to measure competently the several aspects of basketball motor ability?

Our analysis of the motor aspects of basketball revealed three fundamental and general skill areas; ball handling, basket shooting, and jumping. Ball handling includes speed and accuracy of passing and catching, bouncing, and general control of the body and ball while in motion. Basket shooting involves both accuracy of aim and speed of execution in scoring. Jumping ability is useful in retrieving balls from the backboard, intercepting passes, and for jump-balls. A confirmation of our analysis is found in the following quotation from Russell and Lange: "A study of basketball as played by girls in the junior high school convinced us that there are at least four fundamental skills essential to the game. These are: (1) jumping and reaching; (2) goal shooting; (3) passing and catching; and (4) dribbling."⁷ Young and Moser also analyze basketball into practically this same group of elements.⁹

Of the three fundamental skills thus analyzed, ball handling seems to involve the greatest variety of abilities. These are further defined as accuracy and speed of passing while motionless, and while in motion; to a stationary player; or to a moving player. A total of twenty-four possible combinations result, and the same number of itemized skills are involved in catching. The skills of passing and catching may also be preceded or followed by a bounce, juggle or pivot. Basket shooting involves three skill factors: (1) the free throw which is stationary and from a specified and identical spot; (2) shooting from any position while stationary and from any spot while in motion, and (3) either of these last two skills may also involve a preceding bounce, juggle, and (or) pivot. Jumping skill seems to have the least number of skill combinations.

This analysis caused us to decide that the basketball motor ability test should probably include one or more ball-handling tests; one or more basket-shooting tests; and one test of jumping. Experiments were conducted during 1936-1938 with a total of ten different subtests.

The ball-handling tests studied were: accuracy pass,* pivot and pass,^{1, p. 24} moving target,^{1, p. 57; 6; 9} and Edgren ball handling.^{1, p. 48; 2}

The basket-shooting tests studied were: nine-spot bounce and shoot,† bounce and shoot—ten points,^{1, p. 59; 6; 9;} bounce and shoot—twenty points,^{1, p. 47} and one-minute goal shoot.^{1, p. 21}

The jumping tests studied were: free jump and reach,‡ and Sargent jump.⁴

The data § from these experiments caused the elimination of six of these tests from further consideration. Four tests were retained and submitted to a series of experiments during 1938-1939. These four were retained for the following reasons:

1. They seemed to give the greatest promise of measuring, singly and in combination, the skills revealed as important by our analysis.
2. The preliminary evidence led us to believe that four tests—two ball handling, one bounce and shoot, and one jumping test—would be necessary to measure completely motor ability in basketball.
3. Each of these tests satisfied the criteria of mechanical setup.
4. Four tests are within the number limit considered desirable as a battery, on the basis of size of group and time available.

The four tests chosen for further investigation were: moving target, Edgren ball handling, bounce and shoot (twenty points), and the free jump and reach test.

Complete directions for the administration of these tests will be found in the Appendix. A suggested floor plan is also included. To compute the basketball motor ability test score, two processes are necessary. First, to convert the raw scores on each of the four subtests into T-scores by means of Tables VIII, IX, or X (Appendix); second, to add these T-scores. The result is the total scale score.

PROBLEM II

VALIDITY—RELIABILITY—OBJECTIVITY

The validity of the basketball motor ability test rests upon four factors: the relationship between the subtests; the relative proportion each subtest contributes to the total battery; the amount of basketball

* To a wall target, scoring too subjective, and difficult.

† Original test, developed at Arnold College to discover spots on a semi-circle, radius being distance from free-throw line to end line, which would most nearly represent all possible spots from which bounce and shoot might be made. Evidence conclusive in favor of two spots just outside free throw circle. Data not included here for lack of space, obtainable on request from authors.

‡ Adaptation of the Young-Moser free jump test.⁹

§ This evidence is not included here for lack of space. Obtainable on request from J. T. Dyer, Arnold College, New Haven, Conn.

motor ability which is measured by each subtest; and the relationship between the test, as a whole, and the activity it is supposed to be measuring, that is, basketball motor ability. The evidence pertaining to each of these factors will be discussed.

Intercorrelations.—The relationship between subtests is shown by the coefficient of correlation of each test with every other test.

TABLE I
COEFFICIENTS OF INTERCORRELATION*

Level	N	MH†	MB	HB	MF	HF	BF
Arnold	109-118	.53	.38	.45	.25	.40	.25
Lacrosse	68	.30	.23	.31	.06	.27	.34
New Haven	68	.36	.26	.27	.32	.47	.27
Westport	77	.56	.45	.41	.26	.44	.32

* Pearson *rs*.⁴ The authors wish to take this opportunity to thank the Arnold College students, Rhoda Levy, Irene Burda, W. A. Pudvah, Jr., and Lyle Benvenuti for their valuable assistance in checking the statistical computations.

† Key to letters; M, moving target test; H, Edgren ball handling test; B, bounce and shoot test; F, free jump and reach test.

The coefficients, at each level as shown in Table I, are all low, ranging from .06 to .56, and indicate that the tests are all measuring different factors. There is, therefore, no duplication, and all the subtests are probably necessary.

Correlation with Total Scale Scores.—The relative proportion that each subtest is contributing to the battery is shown by correlation between each test and the whole test. These coefficients, at each level, are

TABLE II
SCORES ON SUBTESTS CORRELATED WITH TOTALS

Level	N	M	H	B	F
Arnold	81	.82	.74	.83	.59
Lacrosse	68	.63	.63	.68	.60
New Haven	68	.68	.76	.68	.74
Westport	77	.76	.77	.76	.60

fairly high, between .60 and .80,^{4,p.342} and fairly consistent among themselves, and from level to level. They indicate that, at all levels, each test is making a proportional contribution to the battery, and that no one test item is contributing either more or less than any other item.

Validity of the Subtests.—From one to three criteria were developed to show, by correlation with each test, the degree to which the subtests are actually measuring basketball ability.

Criterion A at each level is a rank order list of the players, based on the judgment of the experimenter as to their playing ability.

Criterion B, used with the Arnold and Westport data, is also based on expert judgment. The available cases were classified in one of nine categories. Plus 4 included the very best players, plus 3 the next best group, down through plus 2 and plus 1. The largest group, the average players, were included in the 0 (zero) category. Minus 1 indicated those players just slightly below the average, and so on through minus 2 and minus 3 to minus 4, in which category were placed the very poorest players in the group. Criteria A and B were developed independently of each other, and then a careful cross check made to detect and remedy any inconsistencies.

Criterion C, used only with the Arnold Data, is a rating by the experimenter of the players while in actual games. Each player was

TABLE III
CORRELATION OF SUBTESTS WITH CRITERIA

Level	N	M	H	B	F
Arnold					
Crit. A* <i>judg</i>	37	.76	.71	.59	.50
Crit. B† <i>experimenter</i>	37	.80	.84	.84	.82
Crit. C‡ <i>plot</i>	34	.65	.57	.66	.66
New Haven					
Crit. A‡	13	.47	.45	.69	.56
Westport					
Crit. A‡	20	.70	.76	.55	.80
Crit. B†	35	.86	.80	.82	.80

* C. Hull, "Computation of Pearson r from Ranked Data," *Journal of Applied Psychology*, 6(1922)385-390.

† Coefficient of Mean Square Contingency; $C = \frac{\sqrt{P-1}}{P-1}$ (4, p. 392)

‡ Rank Difference Method of Correlation. (4, p. 360 & Table 45)

rated from three to five different times playing in the games of a round-robin tournament. The final rating was the average of all the ratings given each student. The ratings were done on a 0 to 10 point basis, using as a standard of excellence, actual contribution to the team efforts toward winning. Those players who were most valuable in helping the team to score, or in preventing the opponents from scoring, were rated 9 or 10. Other players were rated proportionately. All players were both guards and forwards during the games, according to a local rule of competition. The average ratings were then ranked, because of the small numbers. An examination was made of the reliability of two of the criteria. The correlation between criterion A and criterion C was found to be .95, showing that these judgments agreed well with each other.

Table III presents the validity coefficients of each test with the various criteria at the three levels. In evaluating these coefficients, two factors must be taken into consideration, in addition to the size of the coefficient.

First, there is the fact that in each instance the number of cases is small. However, the cumulative evidence of a repeated tendency, such as here presents itself, exhibited by numerous small groups may be taken as offsetting the weight of few numbers of cases.

Second is the fact that since each test is intended to measure a part of basketball ability, and the criteria are representative of total basketball ability, the correlation between a single test item and a criterion will not be high. Coefficients ranging from .50 to .80 may be accepted, under these circumstances, as showing that the test items are valid measures of parts of basketball ability.

Taking all these factors into consideration, the conclusion may be made that the subtests are reasonably valid, within the limits of probability, based on these criteria and these cases. They are fairly consistent from level to level, which leads to the conclusion that these test items are probably valid for use with junior high school girls, high school girls, or college women.

Validity of the Basketball Motor Ability Test.—The evidence showing that the basketball motor ability test, as a whole, actually is measuring the skills of basketball is of three types: correlation of total scale scores with the same criteria discussed above; multiple correlation with criterion A; and the significance of the difference between means of various groups, using the critical ratio technique.

The validity coefficients shown in Table IV are fairly high and fairly consistent from level to level. The generally accepted standard for validity coefficients of a battery test is .90 or better. The basketball motor ability test coefficients run from .76 to .91. Evaluation of these coefficients must take into account the fact that the criteria all involve more than just basketball motor ability. The criteria used are based

TABLE IV
WHOLE TEST AND CRITERIA, VALIDITY COEFFICIENTS AND MULTIPLE R's*

Level	N	<i>r</i>	R C(MHBF)	R C(MHB)
Arnold				
Crit. A†	37	.80	.90	.87
Crit. B‡	37	.86		
Crit. C†	34	.83		
New Haven				
Crit. A†	13	.76	.80	.80
Westport				
Crit. A†	20	.91	.98	.87
Crit. B‡	35	.87	.97	.88

$$* R_C(\text{MHBF}) = \sqrt{1 - [(1 - r_{CM}^2)(1 - r_{CH.M}^2)(1 - r_{CB.MH}^2)(1 - r_{CF.MHB}^2)]} \quad (4, \text{p. 432})$$

$$R_C(\text{MHB}) = \sqrt{1 - [(1 - r_{CM}^2)(1 - r_{CH.M}^2)(1 - r_{CB.MH}^2)]} \quad (4, \text{p. 432})$$

† Rank Difference Method of Correlation, *op. cit.*

‡ Coefficient of Mean Square Contingency, *op. cit.*

on the total picture of basketball playing ability, whereas the test taps only, and specifically, the motor ability aspects of the game. Each of the criteria used contains, to a greater or less degree, the judges' evaluation of cooperative team play, strategic ability, basketball smartness, and other intangibles, which the test makes no attempt to measure. The basketball motor ability test is intended as an instrument for the measurement of the motor skill involved in basketball only, and therefore these coefficients may be interpreted as showing that the test has an acceptable degree of validity.

The multiple R's with all four subtests in their best combination confirm the hypothesis that the test is a valid instrument. Multiple R's with only the first three tests were computed, and are included in Table IV, because certain of the data led us to suspect that the ability measured by the free jump and reach test was not essential to basketball. The fact that the multiple R's based on three tests closely approximate those based on four tests indicates that our suspicion is at least partially confirmed. This evidence leads to the conclusion that the three-test battery is almost as good as the four-test battery for those above junior high school age. Therefore, if limitations of time would prevent the administration of four tests, the three-test battery may be used with almost the same degree of confidence at the college and high school levels. For the junior high school groups, the free jump and reach test is apparently necessary. More research is needed on this point.

Critical Ratios.—The value of our use of the Critical Ratio technique in demonstrating the validity of the basketball motor ability test rests upon two fundamental assumptions.

First, if two groups of players are selected, prior to the administration of the test, one of which is known to be high and the other known to be low in the ability to be measured, the test may be accepted as valid if the high group scores significantly better on the test than does the low group. The significance of the gap between the highs and the lows is determined by the ratio of the difference between the means of the two groups to the standard error of the difference. If this critical ratio is 3 or more, the conclusion may be made that the test has brought to light a true difference, since there are 68 chances out of 100 that a repetition of the experiment will show a difference in favor of the same group as great, or greater, than the one obtained this time.

The first half of Table V presents the critical ratio data on high versus low groups. For the Arnold data, it was assumed that those six individuals who would, at the end of the intramural basketball season, be elected to the Honorary Varsity were distinctly superior in basketball ability to the remainder of the players who were not so chosen. The high and low Lacrosse players were selected respectively from a group of twenty-five seniors, and a group of forty-four freshmen. The high and

low Westport players were selected from a larger group composed of thirty-five players.

All the critical ratios are above the accepted standard of 3.⁴, p. 133. Therefore, since the cases were originally selected because of their known superiority and inferiority as basketball players, the test does measure basketball ability. It unerringly discriminates between the good and poor basketball players.

TABLE V
CRITICAL RATIO DATA

Level	N	Means	Standard Error Diff. Means *	Critical Ratios †
Arnold				
Varsity	6	299.5	12.93	5.77
Group	35	224.8		
Lacrosse, Srs.				
Highs	9	232.0	14.67	4.18
Lows	10	170.7		
Freshmen				
Highs	10	207.8	6.46	3.94
Lows	9	142.9		
Westport				
Highs	10	287.7	9.50	8.50
Lows	10	206.5		
Arnold				
Pre-season	39	204.5	5.41	6.01
Post-season	39	237.0		
Westport				
Pre-season	35	206.0	4.19	9.80
Post-season	35	247.0		

* Formula used in upper part, $\sqrt{\sigma^2 M_H + \sigma^2 M_L}$ (4, p. 211)

Formula used in lower part, $\sqrt{\sigma^2 M_H + \sigma^2 M_L - 2r_{ML}\sigma_{M_H}\sigma_{M_L}}$ (4, p. 218)

† Critical Ratio derived from $\frac{D_{M_H M_L}}{\sigma_{M_H M_L}}$ (4, p. 213)

The second assumption argues that the basketball ability of a group can normally be expected to be greater at the end than it was at the beginning of a period of instruction, practice, and participation. If, therefore, the test demonstrates the results normally to be expected, that is, substantial and statistically significant increases in test scores from the pre-season testing period (December, 1938) to the post-season test (March, 1939), it would seem highly probable that the test actually does measure basketball.

The instruction and participation must, of course, have been adequate. The two experimenters using this technique have had ten and five years' experience teaching and coaching basketball. The groups each

received instruction once a week and participated in at least one game a week and sometimes two. Therefore, both the quality of instruction and the quantity of participation may be accepted as having been adequate.

The second part of Table V presents the critical ratio data of the mean score at the beginning and the end of the basketball season for two levels. Both critical ratios are well over the required 3. These data indicate that a significant amount of improvement in test scores existed. Therefore, on the basis of our original assumption that instruction and participation in basketball will, normally, increase ability in basketball, the conclusion may be reached that the basketball motor ability test actually is measuring what it is supposed to measure, since it detects, to a significant degree, this expected increase in ability.

Reliability of the Basketball Motor Ability Test.—Factors which tend to make a test unreliable are reduced to a minimum in this test. Critical analysis of each subtest shows that the test conditions and equipment can be kept constant. Directions are exact, and the administrative procedure is precise. There need be no appreciable variation from one testing period to another in these factors. The four tests, taken at one time, are not so strenuous as to cause fatigue to enter the picture. In fact there is every reason to suppose that a second administration of the test, closely following a first application, by the same persons to the same group will produce the same results.

The available statistical data on the reliability of the basketball motor ability test, and of each of the subtests, as developed in our experiments, are presented in Table VI.

TABLE VI
INDICES OF RELIABILITY *

Level	N	Whole	Subtests			
		Test	M	H	B	F
Arnold	39	.89	.74	.70	.70	.91
Lacrosse	25		.91	.92	.69	
Westport	35	.90	.62	.57	.89	.96

* Formula used, $r_{\text{obt. true}} = \sqrt{r_{12}}$ (4, p. 273)

The Lacrosse data are based on scores obtained from two applications of the tests, given from one to three days apart. The Arnold and Westport data are based on scores obtained before and after a four-month period of instruction and practice.

This lapse of time between test and re-test naturally produces reliability coefficients lower than the true reliability of the test. The longer the interval between tests, the more growth and development (especially at the high school and junior high school levels) will affect

the reliability coefficients. Had it been possible to repeat the test within a short time at these levels, undoubtedly the indices would have been higher.

As it is, the indices for the whole test are .89 and .90, at the only two levels where it was possible to repeat all the subtests. On the basis of these data, and taking into consideration the lowering effect of the time lapse between test and re-test, it is reasonable to conclude that the test has an acceptable degree of reliability.

Objectivity of the Basketball Motor Ability Test.—No statistical evidence of objectivity is available. Proof of the statement that the test has an acceptable degree of objectivity rests upon a critical analysis of the test items.

Two factors, in general, tend to influence test objectivity. First, the less the scoring of the test depends upon the subjective opinion of the examiner as to the quality of performance, the more objective will be the test. Second, the less some person, other than the player being tested, is involved in the testing procedure, the more objective will be the test.

Critical analysis of the moving target test indicates that the test is scored on a number-of-hits basis. The only subjective opinion involved is the judgment of the examiner as to whether or not the hit, if made, occurred while the target was passing in front of the 5-foot center area. With a competent examiner, this minute amount of subjective judgment should not affect the objectivity of the test. Two persons, other than the subject, are required to hold and release the target. If these assistants are competent persons, and are properly instructed as to the height at which to hold the target and the precise method of release, their influence in reducing objectivity will be negligible. Therefore, the moving target test may be considered to be satisfactorily objective.

Critical analysis of the Edgren ball-handling test reveals that several elements are liable to subjective opinion. The examiner is required to start the stop watch, count the number of times the ball hits the wall, stop the watch when the ball returns to the player's hands after the tenth hit, and read the score to the nearest half-second. A competent examiner should have no difficulty in making these judgments accurately. No other person is concerned in the testing procedure. Therefore this test may also be accepted as objective.

Critical analysis of the bounce and shoot test shows that the examiner needs to make three decisions based on judgment, none of which, however, are judgments as to quality of performance. If the subject's feet are not outside the free-throw circle when the shot is made, or if the bounce is illegal, the trial is repeated. The ball either misses the basket completely, scoring 0; enters the basket, scoring 2 points; or touches the rim without entering, scoring 1 point. In each case the judgment is not as to worth, but only as to what actually occurred. A competent examiner should be able to administer this test with com-

plete objectivity. No other person is concerned in the procedure. Therefore, this test also may be accepted as satisfactorily objective.

Judgment of quality of performance is not involved in the free jump and reach test, and no other person is concerned in the procedure. The only judgments required of the examiner are accurate observation of the reach height, and of the number of the shortest strip which the jumping player causes to move. By strict adherence to the test directions, a competent examiner should be able to make these observations with complete accuracy.

The objectivity of each of the subtests composing the basketball motor ability test has been examined by the method of critical analysis, and shown thereby to be acceptably objective. Therefore, the basketball motor ability test, as a whole, must have an acceptable degree of objectivity.

Summary and Conclusions.—The subtests of the basketball motor ability test were selected after careful analysis of the fundamental motor elements of skill involved in basketball. Ten tests were investigated during the two-year period, 1936–1938. Four of these ten tests were subjected to further experimentation during 1938–1939, at three levels: college, high school, and junior high school.

It was shown that the subtests are all measuring different aspects of basketball motor ability; all contribute in due proportion to the total score; and all are reasonably valid measures of basketball motor ability of college women and secondary school girls.

It was further shown that the basketball motor ability test, as a whole, has a satisfactory degree of validity as a measure of the basketball motor ability of college women and secondary school girls, by correlation with various criteria, multiple R 's, and the use of the critical ratio technique.

The reliability and objectivity of the basketball motor ability test were subjected to critical analysis and found to be acceptable.

Therefore, the general conclusion may be made that the test is a valid, reliable, and objective measure of basketball motor ability of college women and secondary school girls.

PROBLEM III

SCALING THE TEST ITEMS

To be most generally useful, a test should have norms. No matter how good a test may otherwise be, without norms very little information may be obtained from the scores. If, for example, a student makes a score of 14 seconds on the ball-handling test, what does it mean in terms of good, average, or poor ability? A secondary consideration is the impossibility of combining scores such as these directly. Two of the tests are scored in number of times, one in seconds, and the other in inches.

Therefore, we have constructed a series of T-scales * for each of the subtests at the three levels. A score of 50 on any one test represents the performance level at the mean. A score of 200 represents the mean score for the whole test. Multiple R's, as previously discussed, indicate that three tests are almost as effective as four, and may be used with college women and high school girls when limitations of time prevent the giving of the complete battery. If the free jump and reach test is omitted, the mean total score will be 150.

TABLE VII
BASIC T-SCALE DATA

Test	Level	N	Mean	Sigma	Critical	Ratio
Moving	Arnold	119	6.34	2.75	A & W	3.93
Target	New Haven	138	5.59	2.75	A & N	2.30
	Westport	242	5.20	2.72	N & W	1.34
Edgren						
Ball	Arnold	118	14.99	1.80	A & W	4.07
Hand-	New Haven	102	15.84	2.78	A & N	2.66
ling	Westport	166	16.21	3.24	N & W	.97
Bounce	Arnold	118	13.86	3.40	A & W	3.44
and	New Haven	71	11.02	3.44	A & N	5.57
Shoot	Westport	175	12.52	3.02	N & W	3.10
Free Jump	Arnold	119	18.62	2.39	A & W	8.27
and	New Haven	114	14.82	2.82	A & N	11.18
Reach	Westport	270	16.47	2.34	N & W	5.69

Reference to Table VII will show that the college scales are based on 118 to 119 cases; high school scales on 71 to 138 cases; and junior high school scales on 166 to 270 cases. All of these scales are based on relatively small numbers of cases, and all of the cases were obtained at a single institution for each level. They are, therefore, at this stage purely local norms. The critical ratios tend to show that performance levels at other institutions are likely to be similar to those we have found. Also of significance is the fact that the sigmas for each test are almost identical to all levels. This consistency of variability from level to level would tend to indicate that our data are probably representative.

The Lacrosse data were not included in the college scales, because they were obtained from freshmen and seniors only, and would therefore have distorted the scales. Since the college scales are based only on data from students majoring in physical education, they may not fit the ordinary college group. It is possible, although by no means certain, that separate scales will be necessary for non-major college groups. This point needs further investigation.

It will be noted that the Westport scales do not include different

* Following the general pattern provided by Cozens, Cubberly, Neilson.¹

scales for the usual height-weight classifications. Since the numbers of cases available for the present study were small, it was decided to include them all in one scale for each sub-test. To have done otherwise would have been to divide our cases into absurdly small units. The collection of sufficient data to permit scales built on some classification play is a project for future research. We earnestly solicit such height-weight data, and hope that anyone using the test will send us their data at any one of the levels. Such contributions will be of assistance in the construction of scales on a national basis.

There are certain rather interesting irregularities in the data. The mean for the free jump and reach test is lower at the high school level than at the junior high. Apparently these high school girls lose their ability to jump, but regain it at the college level. Perhaps the fact that the high school girl is undergoing great physical changes may provide the answer. We find the same difference of means in the bounce and shoot test, possibly a result of the same general changes taking place during adolescence.

Certain of the preliminary data made us suspect that only one scale might be needed for each test. The statistical significance of the difference between means at each level was examined by the use of the critical ratio technique. The evidence is conclusive with respect to the free jump and reach, and the bounce and shoot tests. Separate scales are undoubtedly necessary for these tests. For the other two tests, the college scale might possibly be used for the high school level, and the high school scale for the junior high school students, but one scale would not serve for all. Therefore, although the data are not completely definite for all four tests, the weight of the evidence is in favor of three different scales. These scales are presented in Tables VIII, IX, and X in the appendix.

BIBLIOGRAPHY

1. Cozens, Cubberly, and Neilsen, *Achievement Scales in Physical Education Activities*. (New York: A. S. Barnes and Co., 1938).
2. Edgren, H. D., "An Experiment in the Testing of Ability and Progress in Basketball," *RESEARCH QUARTERLY*, 3:1 (March, 1932).
3. Glassow, Colvin, and Schwarz, "Studies in Measuring Basketball Playing Ability of College Women," *RESEARCH QUARTERLY*, 9:4 (Dec., 1938).
4. Garrett, H. E., *Statistics in Psychology and Education*. (2nd ed.; New York: Longmans, Green and Co., 1938).
5. McCloy, C. H., "Measurement of General Motor Capacity," Mimeo., Univ. of Iowa, 1933.
6. Moser, H., "The Use of Basketball Skill Tests," *RESEARCH QUARTERLY*, 6:1 (March, 1935).
7. Russell and Lange, "Studies Relating to Achievement Scales in Physical Education Activities," *RESEARCH QUARTERLY*, 9:4 (Dec., 1938).
8. Schwartz, H., "Knowledge and Achievement Tests in Girl's Basketball on the Senior High School Level," *RESEARCH QUARTERLY*, 8:1 (March, 1937).
9. Young and Moser, "A Short Battery of Tests to Measure Playing Ability in Women's Basketball," *RESEARCH QUARTERLY*, 5:2 (May, 1934).

APPENDIX

TEST DIRECTIONS FOR THE BASKETBALL MOTOR ABILITY TEST

MOVING TARGET TEST

Equipment.—A regulation basketball; two stall bar stools or chairs. A swinging target, and chalk line 10 feet from and parallel to the plane of target movement. Two lines, 5 feet apart, drawn on the wall behind the target, so that center of target, when motionless, lies midway between them.

The target is 18 inches square, made of 1-inch boards, reinforced by 1x4 material, and its weight is approximately 4 pounds. It is suspended by ropes from a height of 11 feet above the floor, in such a way that the lower edge is 3 feet 0 inches above the floor. Harness snaps are used in fastening the ropes to top corners of the target, and to point of suspension. The target may be suspended from the back of the basketball backboard, or from any object of the proper height.

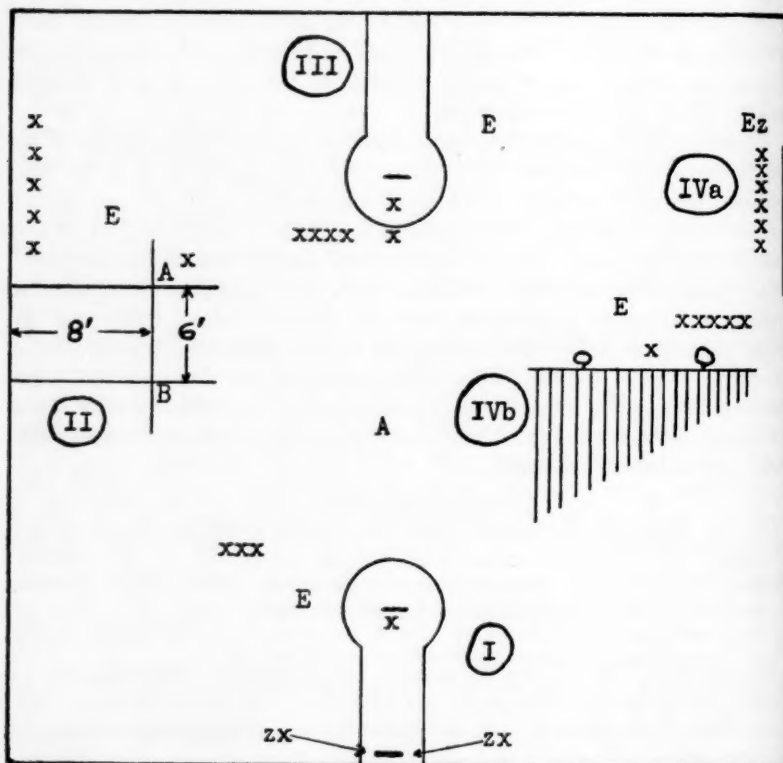


FIG. 1. A suggested floor plan for the administration of the basketball motor ability test to twenty-four subjects.

KEY: Circled Roman numerals locate: I, moving target test; II, ball-handling test; III, bounce and shoot test; IVa, reach height scale; IVb, jump height target suspended from rings. A, administrator, supervising; E, examiners, provided with score sheets for all subjects; x, subjects, in groups of six, who rotate clockwise, progressing to next station immediately on completion of test; z, stools.

Personnel.—One examiner. Two assistants to swing target, who stand on stools at the right and left of the plane of motion of the target. Subjects awaiting turn may act as these assistants.

Procedure.—To prepare the target for motion, one assistant draws it to the side so that its lowest corner is 6 feet from the floor. The target is held between the palms of the hands, and released by parting the hands, thus preventing momentum. (It is extremely important that no impetus be given the target on its release. If any pushing of the target by the assistant occurs, repeat the trial.) When released the target swings to the second assistant on the other side of the point of suspension as a pendulum. Target is released alternately from the right and left.

The contestant, with ball, stands behind the 10-foot line and attempts to hit the target as it swings from one side to the other, and while it is passing through the 5-foot area. No signal for the release is given, but the assistant waits until subject is ready.

Scoring.—The subject's performance is recorded as the number of times out of ten trials that the target is hit while it is swinging through its arc in the 5-foot area.

EDGREN BALL HANDLING

Equipment.—A regulation basketball. A wall on which ball may be bounced. A stop watch. A chalk line 8 feet from the wall and parallel to it. Two parallel lines, 6 feet apart, perpendicular to the wall. The areas formed by these intersecting lines, marked A and B, are the two areas from which the ball is thrown. (See Station II, Fig. 1.)

Personnel.—One examiner.

Procedure.—The subject starts with the ball in area A, makes an angle pass against the wall, and then runs across the 6-foot lane, and recovers the ball in area B. From B she again makes an angle pass to the wall, runs to and recovers ball at A. This process is repeated until the ball has been recovered after the 10th pass. If ball is fumbled and lost, it must be recovered and thrown from the proper area.

If ball is recovered in 6-foot area bounce to proper area before throwing.

One foot must be outside the 6-foot area at the time of the throw. The other foot may be on the floor outside the 6-foot area, or in the air, but may not be touching the floor inside the 6-foot area.

For errors in procedure, repeat the trial after rest.

Two trials are given each subject, separated by a rest period. Two people alternating trials will provide this rest period.

Scoring.—Time is recorded in seconds, to the nearest half-second, from the word "go" to the instant the ball is in the hands of the subject at A, after the tenth throw. The test score is the subject's best performance of the two trials.

BOUNCE AND SHOOT TEST

Equipment.—Two regulation basketballs. One regulation goal, free-throw circle and line.

Personnel.—One examiner.

Procedure.—The subject stands behind the center of the free-throw line, bounces the ball out of the free-throw circle, and shoots for goal. Ten trials are given, alternating right and left. Two subjects take the test at one time, one performing while the other recovers her own ball.

Scoring.—Score two points for each basket legally made. Score one point if the ball hits the rim of the basket without entering.

If both feet are not out of the circle when the throw is made, or if bounce is illegal, repeat trial.

Test score is the sum of points made on ten trials.

FREE JUMP AND REACH TEST

Equipment.—One stool or chair. A scale on large size brown paper, graduated in half-inches, starting at 70 inches and extending up to 90 inches. Attach this reach scale to a clear wall space in such a manner that the bottom line is exactly 70 inches from the floor.

A board to which are affixed 24 graduated strips of wood. The strips hang free from the board, and are numbered plainly from 1 to 24. The shortest strip is 1-inch long; each successive strip is 1 inch longer than its predecessor. This provides a range of 24 inches.

Hang this jump target from a pair of rings, or other convenient overhead apparatus, so that the longest strip is within the reach of the shortest girl, and the shortest strip cannot be reached by the tallest girl when jumping.

Make sure that the board is level with the floor. Then measure the distance of any strip from the floor; the distance of all other strips may be calculated from this one. Prepare a chart giving the number of the strips in one column, and in a second matching column the distance of each strip from the floor.

Personnel.—One examiner.

Procedure.—measure the reach height: Subject faces the reach scale, and with the preferred hand reaches as high as possible, without undue stretching, and places the palm flat on the scale. Record the reach height of the middle finger to the nearest half-inch. The eyes of the examiner should be on a level with, or above, the height to be read. Stand on the stool provided.

To measure jump height: Subject stands beneath the jump target. By jumping and reaching with the preferred hand, she attempts to cause a strip to swing. No steps are allowed. The subject chooses to start on a strip she thinks she can hit. If a strip is swung on the first attempt, proceed to the next highest strip. If the strip is not swung on the first attempt, another try is given. If she succeeds in causing the strip to swing at the second attempt, proceed to next highest strip. If the strip cannot be caused to move on either the first or second strip, her performance is indicated by the last strip she was able to cause to move. From the chart of strip distances already prepared, read the number of inches of her jump which corresponds to the number of the highest strip which she was able to cause to move.

If the subject miscalculates her jumping ability, and so has to jump many times, allow her to rest while someone else in the group takes the test, and then start her again nearer her highest potential jump. Allow each subject one practice jump, before testing, to get the feel.

If the height of the target has been miscalculated, and a few short girls are unable to swing even the longest strip, or a few tall girls can cause the shortest strip to move, postpone measurement of these subjects until all others have been tested. Then raise or lower the target as required. Only the final strip for each of these subjects need be measured for distance from the floor.

Scoring.—After the reach height and jump height have both been recorded, subtract the former from the latter. This will give the subject's ability in inches, to the nearest half-inch, to raise her body from the floor, over and above her standing reach.

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TABLE VIII
ARNOLD COLLEGE T-SCALES

Raw Scores					Raw Scores				
T- Scores	Moving Target	Ball Hand.	Bounce Shoot	Jump and Reach	T- Scores	Moving Target	Ball Hand.	Bounce Shoot	Jump and Reach
100		9.5			50		15		
99				24.5	49				18.5
98					48				
97					47	6		13	
96					46				18
95		10		24	45		15.5		
94			20		44				
93					43			12	
92					42				
91		10.5		23.5	41		16		17.5
90					40	5			
89					39			11	
88					38				
87	10		19		37				17
86		11		23	36		16.5	10	
85					35				
84					34				16.5
83					33				
82		11.5		22.5	32	4	17	9	
81					31				
80			18		30				16
79					29				
78				22	28			8	
77	9	12			27		17.5		15.5
76					26				
75					25			7	
74				21.5	24	3			
73		12.5			23		18		15
72			17		22				
71					21			6	
70				21	20				
69					19				14.5
68		13			18		18.5		
67	8				17	2		5	
66				20.5	16				14
65			16		15				
64		13.5			14		19		
63					13			4	
62					12				13.5
61				20	11				
60					10			3	
59		14			9	1	19.5		13
58			15		8				
57	7			19.5	7				
56					6			2	
55					5				12.5
54		14.5			4		20		
53				19	3				
52					2			1	12
51		14			1	0			

TABLE IX
NEW HAVEN HIGH SCHOOL T-SCALE

Raw Scores					Raw Scores				
T-Scores	Moving Target	Ball Hand.	Bounce Shoot	Jump and Reach	T-Scores	Moving Target	Ball Hand.	Bounce Shoot	Jump and Reach
100					50				11
99					49				
98				23	48		16		14.5
97					47				
96		8			46	5	16.5		
95				22.5	45			10	14
94					44				
93		8.5	20		43		17		
92				22	42				13.5
91					41				
90		9			40	4	17.5	9	
89				21.5	39				13
88			19		38				
87		9.5			37		18		
86				21	36			8	12.5
85					35				
84		10			34	3	18.5		
83			18	20.5	33				12
82					32				
81		10.5			31		19	7	
80				20	30				11.5
79					29				
78	10	11	17	19.5	28	2	19.5		11
77					27				
76		11.5			26			6	
75				19	25		20		10.5
74			16		24				
73		12			23				
72				18.5	22		20.5		10
71	9				21	1		5	
70		12.5			20				
69			15	18	19		21		9.5
68					18				
67		13			17			4	
66				17.5	16		21.5		9
65	8				15	0			
64		13.5	14		14				
63				17	13		22		8.5
62					12			3	
61		14			11				
60				16.5	10		22.5		8
59	7		13		9				
58		14.5			8				
57				16	7		23	2	7.5
56					6				
55		15	12		5				
54				15.5	4		23.5		7
53	6				3				
52		15.5			2			1	
51				15	1		24		6.5

TABLE X
WESTPORT DATA—JUNIOR HIGH SCHOOL T-SCALES

Raw Scores					Raw Scores				
Moving Target	Ball Hand.	T- Scores	Bounce Shoot	Jump and Reach	T- Scores	Moving Target	Ball Hand.	Bounce Shoot	Jump and Reach
100					50				
99					49				
98		7		23.5	48	5	16.5		16
97					47			12	
96		7.5			46		17		
95				23	45				15.5
94					44				
93		8			43	4	17.5		
92			20		42				
91		8.5		22.5	41		18		15
90					40			11	
89					39				
88		9		22	38		18.5		14.5
87					37	3			
86			19		36				
85		9.5		21.5	35		19	10	14
84					34				
83		10			33		19.5		
82					32				
81				21	31	2			13.5
80		10.5	18		30		20		
79					29			9	
78	10			20.5	28				13
77		11			27		20.5		
76					26				
75		11.5	17	20	25	1	21		12.5
74					24			8	
73					23				
72	9	12			22		21.5		
71				19.5	21				12
70		12.5			20	0	22		
69			16		19				
68				19	18			7	11.5
67		13			17		22.5		
66	8				16				
65				18.5	15				11
64		13.5	15		14		23		
63					13			6	
62		14			12		23.5		
61				18	11				10.5
60	7				10				
59		14.5			9		24		
58			14	17.5	8				10
57					7			5	
56		15			6		24.5		
55				17	5				9.5
54	6	15.5			4		25		
53			13		3				
52					2				
51		16		16.5	1		25.5		9

Improving the Construction of the Essay and Objective New Type Examination

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ONE important phase of our health, physical education, and recreation program today is the making and the giving of paper and pencil examinations. Most of us find ourselves, either at the middle or the conclusion of each semester, devising the essay or the modern new type objective examination in the hope that such tests will better enable us to grade knowledge achievement or improvement in our students.

In the past we have given very little consideration or thought to the construction of such tests. Most of the examinations we have given violate the majority of principles of good test construction. You can't throw together a group of questions an hour or so before the examination and expect valid results. You will agree with me, I am sure, that such practices are very much in evidence today. If we are to give examinations—and believe me, I do feel that testing has its part to play—then it behooves each member of the profession to take this responsibility upon his shoulders and do the job as it should be done.

Testing has no place in our program if the test does not serve the student. This is one cardinal rule that must never be forgotten. The old rule is still good today, that a test is only valuable when it helps the teacher serve his pupil better. Too much in the past we have over-emphasized the mastery of the particular subject matter rather than the actual changes that were taking place in our students. Likewise, we have attempted to measure individual growth in terms of mastery of unrelated facts or skills along a fixed line. Today's aim of education—and that includes us in health, physical education, and recreation—is to measure, if possible, growth in terms of individual development of attitudes, appreciations, knowledge, skills, habits, and effective reflective thinking. Such a philosophy considers the individual as continually developing, and capable of attacking and adjusting to new problems as they arise in the ever changing environment.

Before going into the matter of setting forth step by step direc-

A paper presented before the Administrative Measurements Section of the American Association for Health, Physical Education, and Recreation, San Francisco, April 3, 1939.

tions in knowledge test construction, permit me to list some of the outstanding points for and against the essay and the objective new type examination. Since we use the essay examination least nowadays, this type will be considered first.

Many who use the essay type examination exclusively feel that the essay examination, if constructed carefully and correctly, will measure a greater number of processes than any other type of test. The essay proponents feel that questions of this nature are very vital as motivating forces, in that they require more reflective thinking, organizing ability, and individual expression upon the part of the student than do other types of tests. Essay questions are not so apt to confuse the student, due to the fact that statements are generally broad in scope. Since a general understanding is more essential in this type of examination, students are not so apt to cram into their heads before the test many unrelated, insignificant facts.

On the other side of the fence, opponents criticize the essay examination because it too often is overly subjective. The personal bias element is difficult to eliminate. It lacks objectivity. We all know how teachers' marks vary and what a tremendous amount of time is wasted in attempting to grade the written examination. It has been said that one possessed with the ability to "gush" forth with the "King's English" usually gets the best grade in the essay examination whether he knows the pertinent facts or not. "Bluffing" pays dividends.

In a study made on essay examinations by The Committee on Improvement of College Teaching at the University of Oregon,¹ it was found that the chief weakness of the essay examination was due to faulty construction of the test, rather than weakness of the essay examination itself. The majority of the essay examination questions studied in this survey showed similar mistakes. In the first place questions failed generally to sample the subject field in question. Second, the questions asked were generally loose, broad, ambiguous and allowed a great deal of misinterpretation and "bluffing." In many instances, questions were not specific enough to make way for definite answers, resulting in a great deal of overlapping from one question to another. The committee concluded that the essay test could be made more reliable and valid if questions were carefully stated and there were enough questions to sample the whole field in question adequately. Recommendations made were that essay questions should be of a problem-solving nature. Good essay questions should require a certain amount of analyzation, interpretation, application of principles, synthesis, organization, comparison, criticism, and the enumeration of facts.

¹ Committee on the Improvement of College Teaching, "Essay or Traditional Type Examinations as Used at the University of Oregon," University of Oregon, 1931.

MODERN NEW OBJECTIVE TYPE EXAMINATION²

The disciples of the modern new objective type examination can likewise be criticized for their faulty test construction. Most of the tests we find in our profession are hurriedly put together, usually the day before the examination is to be given. Little or no actual thinking has been given to the validity and reliability of the questions themselves. Upon close observation we find questions poorly worded and stated. Give-away words such as "always," "never," "all," "sometimes," and "usually" are frequently used. Statements are confused by using two or more complete ideas in one question. Double negatives are used. Worse still, we find questions answered by some other previous question. Generally the English used in statements is poor, and sampling of the activity or skill in question is often inadequate. The conclusion from such poor test construction results in nothing more than complete failure to accomplish our objectives.

If the objective test is carefully constructed according to accepted principles, we find numerous advantages. In the first place, personal bias, teacher or subjective element, is eliminated; sampling of the subject in question can be far more extensive; scoring is much quicker and easier. From the student standpoint, "bluffing" is out. Real thinking may be evinced by using various types of questions, notably the multiple response and completion.

In making the objective type examination, important steps to follow are:

1. *Set up the Criteria.*—What are the objectives of the course? What particular factors should the students possess?

a) Elements or objectives determined by:

- (1) Judgments of competent persons in field.
- (2) Analysis of courses of study or texts.
- (3) National committee recommendations.

2. *Validate the Criteria.*—If your criteria are valid, your test will show:

- a) Improvement of scores for different age levels, or,
- b) Improvement of scores after instruction.
- c) High correlation with outside criteria—another similar test is given and scores compared with your test.

3. *Setting up Component Parts of Your Test.*—From your experts, one to five, (not more than ten necessary) or from your readings (number of pages given to particular phases) you can ascertain *importance* of the various test elements.

a) The following is an illustration of the important elements for a Tennis Knowledge Test, with weightings and percentage evaluations.

² Jack E. Hewitt, "Comprehensive Tennis Knowledge Test," *RESEARCH QUARTERLY*, 8:3 (October 1937) 74.

(1) Fundamentals of the game.	
(a) Serving	10%
(b) Forehand drive	10%
(c) Backhand drive	10%
(d) Chop and slice	2%
(e) Volley	3%
(f) Half-volley	3%
(g) Smash	2%
Total (1)	40%
(2) Rules of tennis	25%
(3) Playing situations.	
(a) Styles	12.5%
(b) Strategy	12.5%
Total (3)	25%
(4) History of tennis	5%
(5) Equipment for the game	5%
Total	
100%	

b) Decide upon the total number of questions you will have in the final battery. Also, whether you will make one or two forms, e. g., forms A and B.

(1) If you start out with 200 questions, you can determine from your percentages the number of questions for the component parts of your test, e. g., if you have allowed 40 per cent for fundamentals of the game, then you should have a total of 80 questions out of 200. This weights the questions that are deemed most important in your activity.

c) Next you must decide which technique you will use.³

- (1) True and false questions.
- (2) Recall questions.
- (3) Completion.
- (4) Multiple choice—three or five question type.
- (5) Diagrammatic.
- (6) Yes and no.

d) Drafting the items.

(1) Best to write each item on a 4x6 card—giving the answer to the question and where the item was taken, e. g., author and page. (Essential in case of rechecking.)

(2) All items on your cards will be listed under the major topics

³ See G. H. Ruch, *The Objective or New Type Examination* (New York: Scott, Foresman and Co., 1929).

for your test, e. g., all questions on serving in tennis will come under *a*, 1.

(3) Best to have 30 per cent to 50 per cent more questions than you plan to use, for this allows for elimination of poor questions.

(4) Sort questions into groups under your major headings from your cards.

e) Rechecking the items.

(1) Read statement over for poor wording or misinterpretation.

(2) Avoid the following in your statements:⁴

(a) Obsolete words.

(b) Bad phrases.

(c) Give-away words, as only, never, always, usually.

(d) Avoid misspelled words.

(e) Avoid abbreviations.

(f) Avoid tricky use of singular and plural words.

(g) Avoid all modifiers which do not aid to clarify the thought expressed.

(h) Avoid ambiguous use of "that" or "those."

(i) Avoid an omitted subject or predicate.

(j) Avoid slang.

(k) Avoid first person statements—always put statements in third person if possible.

(l) Avoid any statement in which the answer of one statement is contained or suggested by another question.

(m) Avoid, if possible, degree or comparison statements, for usually two out of three degree or comparison statements are true.

(n) Avoid, if possible, cause and reason clauses, for usually two out of three cause and reason clauses are false.

(o) Lastly, avoid "always" and "never" statements, for usually two out of three of these questions are false.

f) Put your items in order of difficulty. This can be done by having two or more teachers in the field or in your school who have had some experience in the particular activity rate each item from 0 to 10, 10 being the hardest. Easy items must come at the beginning of the test, hard ones toward the end. After you have given the test, tabulate for each question the percentage of students getting the statement correct or wrong. Beginners will miss over 50 per cent, while the advanced group should answer over 75 per cent right. Eliminate poor statements—those too difficult or too easy.

g) Instructions essential throughout your test. Instructions must be specific and clear. Tell students how the examination will be

⁴ C. C. Weideman, "How to Construct the True-False Examination" (New York: Bureau of Publications, Columbia University Contributions to Education, No. 225, Teachers College, Columbia University).

answered, e.g., *T* for true and *O* for false. If you do not want your students to guess, include in your statement that "guessing reduces your score," etc.

h) Scoring.

(1) For true and false statements, best to have answers either come at the end of the question, or just before. Construct it so that all answers come under one another. This makes for ease of scoring.

(2) For completion statements, if it is possible, have all your fill-in lines come under one another.

(3) Give whole credit for each statement.

(4) Scoring methods.

(a) Chance formula for *T* and *F*, use *R* minus *W* (right minus wrong). This considers the fact that you can get half right by merely guessing and your score thus would be zero.

(b) For completion with five possible answers, use *R* minus *W*/4. If using only two responses, use *R* minus *W*. If using three responses, use *R* minus $\frac{1}{2}$ *W*.

(c) Diagrammatic, use the number right.

(d) Completion, use the number right minus number wrong.

(e) Matching, use the number right.

4. *Reliability.*—The consistency with which the measuring instrument (test) gives a constant score.

a) Re-test with same students within short period of time. Run simple correlations. High correlations show reliability of test.

b) Check the scores on your test, if possible, with some other known, reliable test. This means giving two tests to a small group.

c) If no outside criterion is available, divide the test into two forms. Correlate the odd vs. the even questions using the Spearman Prophecy formula. Self correlation for half the test should be above .90.

5. *Time.*—Time is a big element in testing. Testing must not take too much of student's or teacher's time.

6. *Cost.*—The test must not cost too much, either to make or to give.

7. *Lastly, Put All Your Scores on Comparable Basis.*—Transform all your test scores into T-scale scores. This is worked out from the mean by allowing 50 points at the mean. For each standard deviation on the plus side of the mean, allow 10 points. In other words, 1 plus standard deviation when added to the mean score would equal 60 points. The 0 points is 5 minus standard deviation, and 100 points is 5 plus standard deviation.

Formula:: $\frac{10 \times \sigma}{100} = \text{unit per point on the } \sigma \text{ scale.}$

POINTS TO REMEMBER IN CONSTRUCTING THE ESSAY
EXAMINATION

1. Be sure you have enough questions to sample adequately the whole activity in question.
2. Make your questions specific. One general idea in each statement is best.
3. Be careful about English construction. Refrain from using trivial and tricky words.
4. Be sure to include statements that require not just factual information, but also (a) analyzation, (b) interpretation, (c) application of principles, (d) synthesis, (e) organization, (f) comparisons, (g) criticism, and (h) enumeration of facts.

BOOK REVIEWS

MODERN TRENDS IN PHYSICAL EDUCATION FACILITIES FOR COLLEGE WOMEN.
Ruth Elliott Houston. (New York: A. S. Barnes and Co., 1939) 198 pages, illustrated, \$5.00.

Sincere praise is merited by the author in preparing so timely a book. Interest in facilities and equipment for physical education programs, especially for women in colleges, has reached a high point, and the material presented in this book is particularly valuable to departments of physical education, administrators, and architects who are looking for assistance in solving practical problems of building.

In her introductory chapter, the author states the facts concerning developing practices in the field of higher education of women, reviewing the changing philosophy in the past fifty years and the lag in equipment and facilities to meet the needs of this philosophy. Only at rare intervals is an architect called upon to plan a physical education building, and not being familiar with the underlying principles of the program, he is at a loss for adequate information unless he has an opportunity to consult with those directly concerned with such a program. But even this group may not have had contact with a variety of situations, nor is information in the form of plans and illustrations available. The aim of this book is to meet this need through authoritative information gained by visits to college campuses, conferences with directors and architects, perusal of catalogs, presidents' reports, records and bulletins, and presentation of this material by the use of architectural plans of a variety of institutions and photographs of exteriors and interiors.

A brief historical sketch of physical

education for women in the colleges provides a background for discussion of the development of facilities in four state institutions and three privately endowed ones. Attention is called to additions to the activity program and the startling innovations in costumes for women which have made possible the rapid building up of the women's program. Special problems in departments for women in each of the seven colleges studied are considered as to the addition of facilities to meet the growing number of activities and the demand for increased time allotment, credit, and training of teachers.

The main body of the book covers thoroughly an analysis of the physical education buildings in seven representative colleges. As the author states before presenting detailed descriptions of the complete plans, she has considered them from the point of view of a continuously expanding program of physical education. The exteriors are presented in photographs and descriptions to obtain, first, a general impression and bring before the reader differences of architectural design in different decades; blending of colors and structural materials; relationship of outdoor facilities to the buildings; vistas which give aesthetic pleasure; spacious areas and secluded spots for outdoor activities. The interiors are given similar treatment to show advantageous placement of locker and shower rooms, pools, gymnasiums, toilets, corrective rooms, dance studios, administrative offices, and details which are so important in the smooth functioning of such a plant and which are so often given little thought in building because of lack of knowledge of attendant problems.

This volume is outstanding in richness of content and beauty of illustra-

tion. It contains a wealth of photographs of great artistic merit and the reader regrets that it was possible to include in the completed work only about half of those in the original study. Departments of physical education will find this study of great assistance in future planning. If it had been available a few years ago they would have found themselves more capable and more courageous in making suggestions to Boards of Regents in difficult situations which arose during a rather active era of building.

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THE ADMINISTRATION OF HIGH SCHOOL ATHLETICS. Charles E. Forsythe. (New York: Prentice-Hall, Inc., 1939) 413 pages, \$2.00.

The Administration of High School Athletics is a book that I would suggest every high school should have, and one they will find most helpful and practical. A very competent and thorough discussion is given of the various phases of the athletic program.

The author has a sound philosophy on the relationship of athletics to the total education program and is not in the least dogmatic in his discussions and suggestions.

All phases of the many problems in athletics have been well presented, and it is left to the individual to choose what he feels would be the best solution to any specific problem.

Objectives of the athletic program from the standpoint of the school, participant, and the community are well presented. The many illustrations given in regard to reports, records, budgets, etc., are a constructive help to any administrator, either young or old. The discussion of athletic eligibility standards and of local policies and administration cover, as do others, both the large and small school situations.

A real need in the athletic administration field has been met with this book and I heartily recommend it, particularly

to high school athletic administrators.

Some might criticize the author's tendency toward conservativeness but from the standpoint of general usability of the material presented, perhaps this is a decided asset.

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CINÉ-SPORTS LIBRARY. Dean B. Cromwell. (Indianapolis: International Sports, Inc., 1939) \$1.00 each, entire series, \$8.00.

The Sprint Races
The Pole Vault
The Circus
The Broad Jump
Middle Distance Runs
The High Jump
The Shot Put
The Hurdles
The Javelin
Distance Runs—Cross Country

Some twenty years ago, a series of inch-square booklets flooded the grab bag prize market. Flipping the pages through the fingers created an illusion of motion to the figures drawn there—figures of race horses, of cavorting clowns, or of risqué dancers. This same idea, aided by the clearness and reality of modern photography, is the distinctive feature of this new Ciné-Sports series on track and field athletics.

It's an excellent idea, too, for it makes possible a great many views which give a true picture of the development of all phases of form. In the book on pole vaulting, for example, ten series of from fifty to one hundred pictures each are used. The largest photographs are two by three inches in size and show Dills of Southern California clearing the bar. A smaller picture illustrates the form of Day, of the same school; while the other eight portray exercises which are valuable to the conditioning of vaulters. The pictures are excellent, being clear and taken from angles which best bring out the form.

In addition, the books allow space for explanatory comment which helps

to avoid the misinterpretations which might mislead the untrained eye. These comments also deal with such important items as training schedules, diets, and track psychology which the pictures alone cannot cover.

Finally, the plan permits ready use of the books, since each is but four by six inches in size and so may be carried easily in the coach's or athlete's coat pocket, or perhaps attached to a chain in the locker room where athletes can peruse the form of champions at their leisure.

Of those volumes which have appeared to date, the reviewer has but one criticism to make. That is concerned not so much with what has been written as with what has been omitted. In an event as complicated to learn and coach as the pole vault, a large size volume might be printed. Yet here eleven of the one hundred twenty four small pages are blank and many contain but a sentence or two. One cannot but hope that the editor of the series, Dean Cromwell of Southern California, will, in the forthcoming books, divulge a little more from the great store of knowledge which has undoubtedly been instrumental in making his track teams the greatest in the country.

In general, however, the series is definitely of value to both coach and athlete, and is worthy of high commendation.

J. KENNETH DOHERTY
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THE PHYSIOLOGY OF EXERCISE. James Huff McCurdy, M.D., and Leonard A. Larson, Ph.D. (3rd ed.; Philadelphia: Lea & Febiger, 1939) 349 pages, \$3.75.

The 349 pages comprising the 1939 revised edition of *The Physiology of Exercise* are a continuation of pioneer work begun by Dr. McCurdy. Dr. McCurdy's initial interest in the physiology of exercise dates back to 1890. In 1924, his lectures on this subject appeared in what was called the first edition. The second edition, consisting of 270 pages, was available in 1928. The 1939 edition, thus, is an expansion of work and study

that seems to be outstanding in its contribution to a keen study of this all important aspect of health and physical education.

No textbook claims totality of work and study material available and offered to students. Every text, however, seems to stand out as an additional individual contribution to the development of specific aspects of any particular text and reference material. Individuals vary in personal interests. This statement likewise applies to varied environmental settings for direct application of theory and practice. In this connection, Dr. McCurdy represents a generation of work and study in health and physical education.

The outstanding feature of the book seems to be the extensive bibliography utilized. I doubt if there is another American publication in our field that carries such a large number of both American and foreign reference material.

Scientific changes in any decade present new facts and discard those proved unscientific. The research work of various physiological laboratories has accordingly been included by Drs. McCurdy and Larson. Few physical education students have the opportunity to perform personally extensive physiological experiments, and the text material thus opens new avenues of thought. Recent scientific changes incorporated in the text are of distinct value in "keeping abreast of the times," as we say.

Another feature of the new edition is the addition of two new sections: (1) a chapter on exercise for people over forty years of age and (2) a section on exercise for women. The former, as expressed by the authors, is necessitated by the fact that "with the large increase in this section of the population, the normal physiological requirements in strength, skill, and organic capacity become an important consideration for the individual, the physician, the physical education and recreation leaders." The latter presents "the particular problems related to women's physical exercise."

An additional feature is the division of the extensive material into three parts.

Part I deals with "General Effects of Exercise Upon Bodily Functions." Part II lists "Effects of Special Types of Exercise Upon Bodily Functions," and Part III presents "Methods of Indicating Efficiency of Bodily Functions." The first part may be considered as a general orientation and foundation section; the second, as a projection and application of Part I to specific fields of health and physical education; Part III presents certain bodily function diagnostic methods.

This new edition is recommended as follows: (1) as a text for undergraduate college courses in physiology of exercise, and (2) as a reference for both graduate students, instructors, and leaders of health, physical education and recreation.

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THE RELATION OF VARIOUS ANTHROPOMETRIC MEASUREMENTS OF SELECTED COLLEGE WOMEN TO SUCCESS IN CERTAIN PHYSICAL ACTIVITIES. Elizabeth Beall. (New York: Bureau of Publications, Teachers College, Columbia University, 1939) 68 pages.

The investigation reported by the author in this dissertation is an attempt to determine relationships, if any, between anthropometric measurements and selected physical activities, and more specifically: "(1) In what respects do the structural measurements of the successful college woman athlete in a given activity differ from those of the individual who has not achieved success in that activity? (2) Is there any relation between the structural measurements of the successful college woman athlete and the type of activity in which she has achieved success?"

Data were obtained from measurements on sophomores and junior students at Barnard, Goucher, Vassar, Smith, and Wellesley Colleges who were in the upper and lower 15 per cent in skill performances in basketball, swimming, tennis, and modern dance. Later

the groups were reduced to approximately 10 per cent, making a total of 383 cases, divided as follows: 96 for basketball, 74 for swimming, 140 for tennis, and 73 for modern dance. Eighteen bodily measurements were taken.

From statistical interpretations, Dr. Beall summarizes:

"Successful basketball players significantly exceed unsuccessful players in length of upper arm, length of hand, length of entire arm, length of foot, breadth of foot, and breadth of shoulders.

"Successful swimmers show a marked difference from unsuccessful swimmers in six measurements—they weigh more, have broader hands, shoulders, and hips, deeper chests, and a large chest circumference.

"Successful tennis players are taller, have longer trunks and legs, and broader feet than the unsuccessful players.

"Modern dance is the only activity in which the unsuccessful group exceeds the successful group in any measurement; apparently long upper arms and thighs are detrimental to skill in the dance."

Several rather interesting results are shown when one activity is compared with another; for instance, "the greatest number of statistically significant differences occurs between basketball and modern dance . . . a tendency toward a smaller build for dancers is evident . . . length of upper arms stands out as important in comparing basketball with dance, basketball with tennis, and swimming with dance . . ." to mention only a few.

In conclusion, the author states from the results of her investigation that there are "specific structural characteristics which seem to go with success in certain physical activities," and also that "skilled participants in one activity differ with respect to anthropometric measurements from those in another activity . . . that certain specific bony measurements are possessed by a majority of skilled performers in a given activity. . . . Thus the evidence presented does not justify the use of structural measurements as a means of directing college students

(women) into certain physical activities. However, the results might well be considered as factors in predictable success of college women performers" in basketball, swimming, tennis, and modern dance.

It would seem that Dr. Beall has done a grand piece of work in her investigation which might well be used by others as a guide for further investigation. It is clearly written and easily read and understood, even for those not statistically inclined.

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SIX-MAN FOOTBALL. Stephen Epler.
(New York: Harper & Bros., 1938)
250 pages, \$3.00.

Five years ago this fall when Stephen Epler originated his streamlined game of six-man football, he filled one of the biggest gaps in the physical education curriculum for small high schools. Today as the game has spread to a large number of schools, colleges, and recreation centers, it is being used for both interscholastic and intramural purposes.

With this rapid growth, however, an even, bigger need was created; a need for the latest and most authentic information for those engaged in promoting the rapidly growing game. Mr. Epler, the most qualified person to supply this material, has done so with his latest book, *Six-Man Football*.

Dr. William L. Hughes, Ph.D., professor of physical education at Teachers College, Columbia University, has summed up Epler's new book as follows: "The importance of this volume in introducing a new game is apparent. It should prove an invaluable aid to coaches in small high schools, to intramural directors, to playground and recreation workers, to school and recreation administrators, and even to the spectator who would learn more of the technical aspects of the game. This will doubtless be the standard text on six-man football for years to come."

Stephen Epler's book has a universal appeal. He traces briefly, but interest-

ingly, the history and development of the parent game, with its many changes, the origin of the new streamlined adaptation, its phenomenal growth, and finally its place in the educational institution as an interscholastic and intramural sport. The book contains, and thoroughly covers, all the essential information on the fundamentals of the game, the play of individual positions, offensive and defensive team play, coaching and organizing of the game and its administration. The care and safety of the players is stressed throughout. The presentation is educationally sound and practical, with more than 160 pictures and diagrams. Those who want to know what six-man football is all about will welcome this complete handbook.

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HEALTH OFFICER'S MANUAL. J. C. Geiger, M.D., Dr. P.H., Sc.D. (Philadelphia: W. B. Saunders Company, 1939) 148 pages, \$1.50.

This small book is replete with short discussions concerning the administrative aspects of modern public health work. It is based largely on the author's wide personal experience and his opportunities to observe the work of health specialists now employed by large municipal health departments.

Aside from its value as a technical guide for the health official, it contains a wealth of material of direct interest to the sanitarian, public health nurse, the health educator, and others connected with a health department or interested in its management. In fact, all health workers will profit by surveying its contents. The one characteristic which sets this book apart from others of its kind is its direct approach to public health problems and their prevention or control. For the person interested in the "how" and "why" of municipal health work, no better manual is available.

In the main, its contents deal expressly with the purely technical aspects of public health administration. In order,

the author takes up problems dealing with organization, personnel, budget, records, medical services, and inspection and control services. Each subject is given careful treatment. While brief, sufficient data is given the reader to enable him to grasp the principles involved. The author presupposes, however, that the reader will have had sufficient training in public health to grasp the importance of technical subject matter discussed. Consequently, he has dispensed with footnotes, references, and addendum found in other similar texts. The book is fully indexed. Illustrations and graphs, while few in number, are very helpful.

This book serves the very excellent purpose of defining the job of the health officer and the functions of a modern health department. Its brevity and conciseness are at once its outstanding virtues. Busy professional people will value it accordingly. It is recommended to anyone seeking an insight into the scope of modern public health work and especially the functions of personnel engaged in its promotion.

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SCHOOL FOR RIDING. Sergei Kournakoff, Capt. Calvalry, Retired. (Hale, Suchman, and Flint, Inc. 1938) 180 pages, illustrated, \$2.50.

Here is another book on forward riding, which gives simply and clearly the elements of teaching the forward seat. It is written from the angle of teaching a boy from the beginning to the early

stages of hacking and jumping. It is really a series of lessons suitable for a course in forward seat riding for instructors who teach or wish to teach this style. Captain Kournakoff, the author, has taught for ten years at the Boots and Saddles riding school in New York City; his teaching theory is therefore backed by practical application. Throughout the book, however, the instructor has but a single pupil; such individual instruction is not often practical in schools, colleges, or camps. With suitable adaptation, however, the book could be used as a textbook for class or group instruction.

The book has two types of illustrations: photographs which show the progress of the student; and line drawings which show precisely the qualities and defects to be emphasized, and which easily adapt themselves for blackboard use. These illustrations greatly increase the value of the book as a teaching guide.

The content of the book is a detailed study of aids, seat, balance, grip, and rhythm in the rider; the gaits, pace, balance, and way of going of the horse; and the rider's response to the horse's movements.

On the whole, the theory is too mechanical. There is too much emphasis on the correct position, etc., and too little consideration for the temperament of horse and rider. The methods of the book would be suitable for the average pupil and instructor if the school were provided with sufficient forward seat saddles of the correct sizes and with horses schooled to perform as required by the book.

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